Analysing the Environmental Disclosure-Performance Relationship of Australian Mining Companies

By

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Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Author Signed: Adam Beer Date: 23/10/2025

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Abstract

Environmental Sustainability disclosures have become an integral component to current company annual reporting. The innovation of companies choosing to produce publicly available has enabled companies to improve how they account and manage their environmental impacts resulting from their operational activities. The quality of company environmental disclosures can represent the current environmental-related risks that could affect their short and long-term success. Questions remain whether environmental disclosures genuinely represent environmental performance – rather than being a tool for impression management. This research explored the environmental-disclosure performance relationship of 17 selected metal and mining companies from the Australian Stock Exchange (ASX). Research questions focused on how the quality of sustainability disclosure reporting varies among Australian mining companies as well as material environmental sub-topics across the sampled metals and mining industry. Interpretive content analysis was undertaken using a 0-3 scoring criterion. 26 selected material environmental disclosure requirements from the GRI Standard were given a score between 0-3 based on the adherence of the company's 2024 sustainability data. These were totaled and correlated with the company's respective 2024 S&P Global Environmental Score.

A positive strong relationship was evident between total environmental disclosure and environmental performance from the sample mining companies. An early adopter-laggard analysis uncovered key themes to showcase the difference in high and low disclosure quality evident for early adopter and laggard companies: *i) Degree of External Framework Alignment ii) Degree of Quantitative Data iii) Degree of Site-Specific Data iv) Size of Market Capitalisation.* Further linear regression analysis was conducted for four environmental sub-topics (Biodiversity; Climate, Energy and Emissions; Waste; and Water) with variability being seen in their disclosure adherence percentages and r-squared coefficients. The relatively low adherence for the biodiversity sub-topic prompted further examination. The complex and individualised nature of biodiversity reporting, together with varying company sustainability priorities, are drivers behind the reduced disclosure adherence. Therefore, this study demonstrated how mining companies that provide higher quality material environmental disclosures can be positively associated with having an overall environmental performance. Implications of the research suggest that disclosure-related theories support companies wanting to legitimise their environmental actions by providing voluntary disclosures. The ability for stakeholders and investors to analyse environmental disclosure quality by companies can help understand whether they are genuine or used for impression and neutralization purposes.

Table of Contents

List of Figures

List of Tables

List of Boxes

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List of Plates

Delete this if you have no plates

List of Equations

Delete this if you have no equations

List of acronyms and abbreviations

ASX – Australian Stock Exchange

ESG – Environmental, Social and Governance

GRI – Global Reporting Initiative

RQ – Research Question

SASB – Sustainability Accounting Standards Board

TSM – Towards Sustainable Mining

Glossary and Terms

Adherence: The extent to which a company disclosure complies with the expected disclosure requirements set by relevant standards (e.g. GRI).

Early Adopter: Companies that serve as the role model for other companies within their industry. The successful adoption of quality environmental disclosure reporting can accelerate the overall diffusion of similar practices among competing firms (Rogers, 1962).

Environmental Disclosure: Publicly accessible statements encompassing the environmental management practices and accounting from the company's operational activities.

Environmental Performance: Measurable outcome of a company's impact on the environment.

Laggard: Are the seen as the last category to adopt innovation, being relatively cautious that innovation related to environmental sustainability disclosure reporting does not fail (Rogers, 1962).

GRI Material Environmental Topic: "Topics that have a direct or indirect impact on an organisation's ability to create, preserve or erode environmental value for itself, its stakeholders and society at large." (GRI, 2011).

Chapter 1: Introduction

Environmental sustainability reporting encapsulates how companies account and manage their environmental impacts. (Rivo-López et al., 2025). Increasing expectations by stakeholders and investors has become a major driver for companies being proactive towards limiting environmental impacts from their business operations (Miklosik and Evans, 2021). Currently more than 96% of G250 companies integrate sustainability into their reporting, which include environmental topics (KPMG, 2024). These style of reports are commonly titled as 'Environmental, Social and Governance' (ESG) or 'Sustainability' reports by companies (Bosi et al., 2022; Carvajal and Nadeem, 2023; Elshabasy, 2018). Sustainability initiatives disclosed in these reports can be a source of innovation for positive environmental and financial benefits (Ching et al., 2013). Companies that incorporate sustainability disclosures in their reporting have seen improvements to their financial value and long-term success (Laskar, 2018; Miklosik and Evans, 2021).

The structure and quality of disclosures in sustainability reporting still varies significantly between companies (Bosi et. Al, 2022). Australia's mining industry has seen companies incorporate where sustainability and environmental disclosure to enhance their legitimacy and transparency towards addressing their environmental impacts (Miklosik and Evans, 2021; Prno and Slocombe, 2012). Global voluntary disclosure frameworks have helped companies address these impacts by providing relevant disclosure 'checklists' to maintain transparency and standardisation of their disclosures. The recently developed Global Reporting Initiative (GRI) 2024 *GRI 14: Mining Sector* (GRI Disclosure Standard) had recommended various disclosures relevant to the environmental externalities related to mining companies, building upon criticisms of past frameworks that were deemed too broad and generic (GRI, 2025). Additionally, many third-party organisations have incorporated specific metrics to quantify the current environmental and ESG impact of companies against others in their industry (Farnham, 2023; Morningstar, 2025; S&P Global, 2025).

Environmental and ESG disclosure reporting differs from conventional investor and stakeholder interests around evaluating the financial performance of companies found in annual reporting (Brooks and Oikonomou, 2018; Carvajal and Nadeem, 2023). The only current mandatory reporting required of companies in Australia is found within the *Corporations Act 2001*, which has a financial focus. Many commonly utilised global voluntary reporting frameworks also have a financial focus towards the sustainability information recommended for company reporting. For example, the Sustainability Accounting Standards Board (SASB), aligned with over 2000 companies, incorporate financially material sustainability reporting items that are deemed to most likely impact the decision-making of investors (Bradley, L., 2023; Carvajal & Nadeem, 2023).

Increased emphasis on ESG performance of companies has led to a shift towards non-financial information and activities being included in company's reporting (Friede, 2015). Companies see ESG performance as an avenue to improving their transparency surrounding their environmental impacts from their activities (Papoutsi & Sodhi, 2020). Governing bodies in Australia are now recognising the importance of sustainability disclosure as a mechanism for driving change in sustainability outcomes. Recent regulations in Australia have been recently enforced for Australian-listed companies to now mandatorily disclose information in accordance with the Australian Sustainability Reporting Standards S2 (climate-related risks) from January 1, 2025 (Australian Accounting Standards Board, 2024)**.** This represents the policy shift in mandatory disclosure now going beyond financial information requirements, with emphasis on companies being adaptable and aware of the environmental risks that may arise from their activities. As these new mandatory standards are still in their infancy, questions of the effectiveness for companies being able to adapt to these new reporting requirements in such a short space of time. Therefore, there is scope towards better understanding the influence of policy and mandatory disclosure on the quality of companies' environmental information, and whether it can reflect accurately to their actual environmental performance.

1.1 Research Aim and Questions

The research aim of this study was to analyse the disclosure-performance relationship of environmental information provided by Australian mining companies. The findings of this study contribute to the current state of knowledge regarding environmental disclosure practices and trends in the context of the Australian mining industry (Adler et al., 2017; Miklosik and Evans, 2021**)**, To achieve this, the following research questions (RQ) helped guide this study:

1. How does the quality of environmental disclosure adherence vary among Australian mining companies?
2. How does the quality of disclosure adherence vary across material environmental sub-topics, as defined by the GRI Disclosure Standard?

1.2 Thesis Outline

The remainder of this thesis delves further into understanding the environmental disclosure-performance relationship.

Chapter 2 includes the literature review. An overview of the development of environmental disclosure by companies from a national and global perspective is provided with previous academic studies giving context to this type of research. Current research gaps for this study are mentioned given there is the capacity to explore the quality of environmental disclosures from material environmental topics linked to mining companies.

Chapter 3 explains the methodological process behind establishing a self-constructed environmental disclosure-performance framework. Employing the GRI Standard for the disclosure criteria and the 2024 S&P Global Environmental Score (Performance score) for the performance criteria ensured there was credibility to the results. This ensured this style of research could be replicable in the future (Morhardt et al., 2002).

Chapter 4 details the results and data from conducting the disclosure-performance analysis. The distribution of scores is provided for each individual disclosure to detail which of the individual GRI environmental disclosures perform strongly, and which lagged. Furthermore, a variety of simple linear correlation graphs showcase the strength of the total and sub-topic environmental disclosure groups as a measure of environmental performance.

Chapter 5 presents the discussion section, analysing whether the results are supportive of environmental disclosure in company reporting being representative of their environmental performance. An early adopter-laggard analysis based on Rogers (1962) explored thematic differences between high and low-quality disclosure reporting relating to environmental topic disclosure adherence. Further insights are investigated into why gaps in disclosure exist for some environmental topics seen in the mining industry. Additionally, theoretical and practical contributions are detailed to how this research adds to current environmental disclosure-performance literature. Limitations and future recommendations from conducting this study are also highlighted.

Chapter 2: Literature Review

Companies are now prioritising their environmental performance through their sustainability disclosures (Suhatmi et al., 2024). As environmental disclosures provided by companies are largely voluntary rather than legally mandated (Carvajal and Nadeem, 2023), companies can be selective towards what environmental information they choose to disclose (León and Salesa, 2023). Selective disclosures can become an issue where companies can choose mask over areas they perform badly by excluding them from their reporting suite. Prior research has suggested that selective disclosure of topics is often used as a reputational tool rather than a catalyst for genuine environmental improvement (Carvajal and Nadeem, 2023; León and Salesa, 2023).

The environmental disclosure-performance relationship is relevant from both an academic and practical standpoint. From an academic standpoint, there have been limited studies conducted that focus on both the quality and materiality of environmental disclosure, and the link that it has with their environmental performance (León and Salesa, 2023). From a practical standpoint, understanding the relationship between the environmental disclosure quality and performance of companies can their heighten stakeholder, investor and regulator trust (Ching et al., 2013; Ioannou and Serafim, 2021). However, if there are quality and gaps in disclosure reporting, it can undermine stakeholder confidence towards companies manage their environmental impacts (Khan et al., 2021; Pizzi et al., 2024).

The literature review is structured into four main sections:

- **2.1** delves into the background of broader sustainability disclosures being incorporated into company reporting. Context is also provided to the disclosure-performance relationship by providing a disclosure voluntary framework (GRI Disclosure Standard) and third-party rating systems (S&P Global Environmental Score [Performance Score]) to tie together the disclosure-performance relationship.
- **2.2** explores past literature focused on understanding the disclosure-performance relationship. Theories established by Rogers (1962) also aid the formation of the early adopter and laggard analysis for drawing differences between high- and low-quality disclosure reporting.
- **2.3** looks at how the disclosure-performance relationship can be applied to companies in the Australian mining industry, and what existing literature and policies exist that assist in mining company disclosure reporting.
- **2.4** sets out the research gap and study rationale for the thesis.

2.1 Role and Rise of Environmental Sustainability Disclosures

Sustainability has risen in importance from both a national and global standpoint (Herbohn et al., 2014; Suhatmi et al., 2024). Companies are now seeking to improve their transparency and accountability related to the sustainability of their business practices (Dilling, 2010; Sulemana et al. 2025). Signalling theory can help explain the recent uptake in disclosure reporting. Companies that display higher sustainability performance is often the result of their increased sustainability commitment (Papoutsi and Sodhi, 2020). Motivation to provide high quality disclosures is enhanced when the company see greater benefits from publicising the disclosure than what the associated financial cost and time consumption from the environmental disclosure collection and monitoring processes (Brooks and Oikonomou, 2018; Papoutsi and Sodhi, 2020). Legitimacy theory complements signalling theory where companies are pressured to act in accordance with societal expectations (Ching et al., 2013). Companies will adopt sustainability disclosure and reporting to legitimise their actions towards improving their current sustainability performance (Ching et al., 2013; Papoutsi and Sodhi, 2020).

Disclosures reporting related to environmental reporting in Australia is still in its infancy. Mandatory disclosures enforced upon Australian companies have typically had a financial focus given company disclosures were typically linked to their financial performance (Carvajal and Nadeem, 2023). Both the *Corporations Act* (2001) and the *Australian Stock Exchange (ASX) Listing Rules* have shaped companies towards providing financial accountability and transparency for investors, stakeholders and other relevant agencies (Duffy, 2014). However, companies now publish annual sustainability or ESG reports alongside their annual reports to report on non-financial topics (Suhatmi et al., 2024). Environmental sustainability disclosures are public statements regarding the company's environmental performance and impacts over the financial year (Miklosik and Evans, 2021). Environmental sustainability disclosure reporting is commonly formed from external public pressure on the company to reduce the current environmental impact from their operations (Miklosik and Evans, 2021, Morhardt et al., 2002).

The specific environmental topics that are reported by companies can be derived from their internal materiality matrix. Topics in the matrix are prioritised based on the significance of the topic to the stakeholder and the potential impact the topic has on the environment (Dinca et al., 2019; Miklosik & Evans, 2021). Incorporating appropriate environmental topic disclosures to ensure sustainability initiatives are accurately addressed given it is becoming a higher priority area for future company decisions (Ching et al., 2013). Competitive advantages can be gained for companies against their peers by establishing sustainability matrix 'priority' metrics to enhance their legitimacy (Herbohn et al., 2014; Suhatmi et al., 2024).

2.1.1 Benefits from Disclosing Environmental Sustainability Information

Many benefits exist from companies publishing their environmental disclosures in their sustainability reports. Investments in sustainability initiatives and programs have been beneficial to the long-term success and viability of many corporations that participate in sustainability disclosure reporting (Harasheh et al., 2024). Further, sustainability is seen as a mechanism to promote corporate innovation where resources can be efficiently utilised and cost-effective (Laskar, 2018). The implementation of sustainable business practices has been associated with a rise in the in-market value of companies worldwide (Laskar, 2018).

Companies have also seen that sustainability reports can improve their 'green image' by having a reputation that is environmentally conscious and committed towards positive sustainability change (Yadava and Sinha, 2015; Carvajal and Nadeem, 2023). Subsequently, companies have gained competitive advantages where disclosing environmental information has improved their shareholder value and reduced shareholder monitoring costs (Bosi et al., 2022; Laskar, 2018). Greater awareness of environmental impacts has been of greater concern for investors, with emphasis on how increased transparency of sustainability information can enable for more appropriate decision-making and strategy towards minimising their environmental impacts in the future (Doktoralina et al., 2018; Yadava & Sinha, 2015; Vázquez-Burguete et al., 2024). Research has further supported how greater investor confidence in business performance can be associated with the quality of sustainability disclosure provided in their yearly reporting (Miklosik and Evans, 2021).

2.1.2 Disclosure Quality: Influence of External Frameworks to Assist Company Sustainability Disclosure Reporting

The process companies choose to disclose information related to environmental sustainability in their reporting varies greatly (Carvajal and Nadeem, 2023). Sustainability-related reporting has historically been voluntary, meaning companies can be selective in their reporting to create or maintain their 'green' image perceived by the greater public and investors (León and Salesa, 2023). Inconsistencies across government and industry related to disclosure reporting have enabled companies to disclose non-material topics (topics not significant enough to affect the company's environmental performance) and ignore material topics (significant topics that do affect the company's environmental performance) where they may be performing poorly (Carvajal and Nadeem, 2023; León and Salesa, 2023). Governing bodies broadly have been hesitant to enforce mandatory disclosures given the extensive implementation and monitoring processes which can be financially costly and time consuming (Carvajal and Nadeem, 2023). Therefore, there is value for conducting research utilising existing external disclosure frameworks to explore the disclosure-performance relationship of companies.

2.1.2.1 A 'Disclosure' Voluntary Framework: Global Reporting Initiative

Many global organisations have established sustainability disclosure frameworks to assist companies on structuring their disclosure reporting (Yadava & Sinha, 2015). The Global Reporting Initiative (GRI) guidelines is one widely used framework globally, with the first version of guidelines being established in 2000 (Morhardt et al., 2002; Yadava & Sinha, 2015). The GRI is one of the dominant voluntary frameworks for sustainability reporting with 77% of the G250 companies in the world currently aligning their disclosures with their frameworks (GRI, 2025). A holistic approach is applied to the disclosures formulated by the GRI, focusing on each environmental, social and economic dimension. Capturing topics that have broader impacts for a company on society and the environment is prioritised, with a wider audience being able to assess their performance – instead of firm value which is more highly prioritised by stakeholders and investors (Ching et al., 2013; GRI, 2025; Morhardt et al., 2002).

The GRI differs from other sustainability frameworks that tend to have a greater financial focus when setting their disclosure topics, such as the Sustainability Accounting Standards Board (SASB, 2024), The newly updated GRI frameworks have actively aimed to improve upon previous framework criticisms that their disclosure recommendations were too generic. Sector standard frameworks have recently been established by the GRI, with a focus on recommending disclosure topics that are the most material to the company in their industry (Belkhir et al., 2017; GRI, 2025). These sector standards provide 'likely material topics' for companies to report on in that specific industry that GRI deems to be the most material and applicable. Having recommended material topic disclosures allows companies to gain a perspective on which environmental issues they should report on that are related to their operations. Despite the widespread uptake of the GRI framework by companies, it is still voluntary in nature, meaning that companies do have the capacity to modify their sustainability disclosures for their own benefit. Researchers have incorporated previous GRI frameworks into their own studies (Ching et al., 2013; Laskar, 2024; Morhardt et al., 2002; Yadava and Sinha, 2015) suggesting that the GRI is suitable for assessing the quality of environmental disclosures provided by sampled companies.

2.1.2.2 A 'Performance' Quality Rating: ESG Rating Systems and S&P Global

Third-party rating systems focus on certifying and quantifying the sustainability performance of the company (Park and Brorson, 2005; Pizzi et al., 2024). A relevant instrument used to identify sustainability risk and performance are ESG ratings (Arena et al., 2025; Ferreria-Quilice et al., 2023). ESG ratings are defined as 'a scoring framework through which a company's performance on ESG factors is evaluated and measured in a systemic way to yield a combined score" (Arena et al., 2025). These ratings can be viewed in a similar vein to credit ratings, where a company's assessment of their sustainability performance can be easily interpreted to investors and stakeholders (Arena et al., 2025).

ESG ratings are not entirely representative of the company's financial position, with greater emphasis placed on material indicators on ESG factors related to their activities (Farnham, 2023). By having greater access to quality publicly available disclosures, these rating agencies can provide a more accurate rating of the company's sustainability performance to investors and involved stakeholders (Park and Brorson, 2005). Investors are now interested in being able to quantify the level of risk that exists for companies. This includes physical risks like climate change and regulatory changes and transitional risks that may affect their future (Arena et al., 2025). Companies internally are also beginning to see the relationship between ESG and financial performance when incorporating ESG into financial metrics like stocks (Kim & Park, 2023).

Third-party ESG ratings have been essential tools to showcase the quality of disclosure found in company reports by quantifying ESG performance. This is crucial to uncovering whether companies are genuinely committed to integrating sustainable practices that deliver real environmental and overall sustainability progress. One agency that utilises an ESG rating system is S&P Global. S&P Global use publicly available data as a significant component to compiling their scores, with companies also completing questionnaires related to their sustainability performance (Farnham, 2023; S&P Global, 2025). Over 13,000 companies are covered on S&P Global, with company scores being directly related to other companies listed in that industry (S&P Global, 2025).

2.2 Establishing the Disclosure-Performance Relationship

The thesis aim and scope adds on to existing research that examined the quality of environmental and broader sustainability disclosures published by companies. The evolution of articles utilising a GRI scoring framework is evident in previous literature. High quality company reporting encompasses topics with dual materiality, seen in Figure 1. These are topics that not just address the business impact on the environment but have the capacity to influence current and future company financial performance and value (Carboni, 2024).

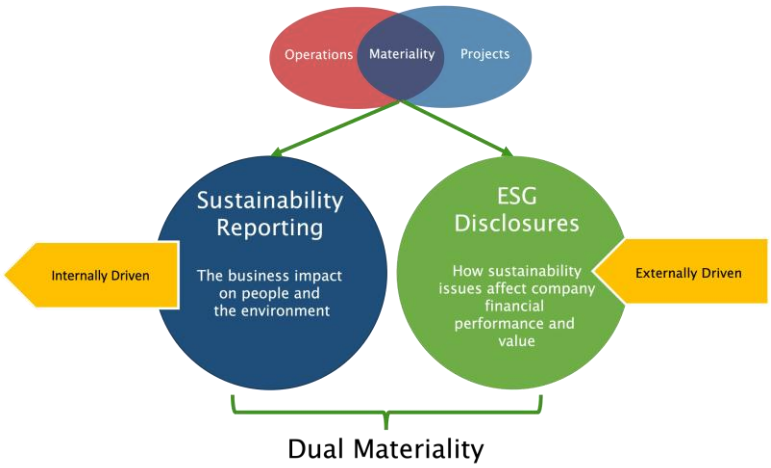

Figure 1: Linkages between Sustainability Reporting and ESG Disclosure - International Sustainability Standards Board (Source: Carboni, 2024).

Previous literature that utilised frameworks outside of the GRI suggested there is a positive association between the two constructs. Papoutsi and Sodhi (2020) used internal sustainability constructs to compare existing ESG measures of companies to determine whether their sustainability reports do indicate corporate sustainability performance. Similarly, León and Salesa (2022) focus on the materiality and quality of GRI disclosures reported by companies in the Spanish telecommunication industry. These articles helped shape the methodological process of this thesis, ensuring disclosures chosen to be scored are relevant to that of the Australian mining industry. Further articles explored how the quality of disclosures were able to positively influence the company's value (Vázquez-Burguete et al., 2024; Eng et al., 2022), suggesting how the quality environmental disclosure can enhance investor confidence.

2.2.1 Early Adopter-Laggard Literature Analysis

Analysing the difference between early-adopter and laggards provides a basis understanding for the variation in disclosure quality seen in company environmental sustainability reporting. Rogers (1962) 'Diffusion of Innovations' pioneered how innovation is communicated through certain channels over time among the members in a group. Within a social system, not all individuals adopt innovation simultaneously. Instead, there is a time sequence to adoption, where the adoption rate can be influenced by company motivation, priorities and their financial flexibility (Rogers, 1962). Recent research has incorporated Rogers' (1962) theory to differentiate well and low-performing companies based on the quality of their sustainability disclosures (Hahn and Kühnen, 2013; Hahn et al., 2018, Clarkson et al., 2008). Hahn and Kühnen (2013) detail how companies when adopting sustainability reporting, can came at the expense of the quality that is. Additionally, Clarkson et al. (2008) that superior environmental performers utilise genuine environmental performance measures to legitimise their management data. Identifying early adopters (favour the innovation before the majority are convinced) and laggards (limited to adopting innovation) is therefore a crucial aspect to adding onto to innovation adoption research.

How effective companies are to achieving their economic, social and environmental goals simultaneously can be reflected in their disclosure reporting (Hahn et al., 2018). Sustainability is an emerging area of corporate governance where companies are expected to incorporate innovation to ensure they are environmental responsible whilst remaining profitable (AASB, 2014). Ediriweena and Wiewiora (2021) demonstrated key 'enablers' for companies overcoming innovation barriers. Enablers such as 'Learning culture' and 'External stakeholder engagement' were listed as factors for why mining companies were able to effectively adopt technology innovation towards improving sustainability outcomes. Exploring the characteristics of two adopter categories (early-adopters, laggards) from the 'Adopters of Innovation' model provides theoretical context to understanding the differences between the quality level of company environmental disclosures.

2.3 Environmental Sustainability Reporting in Australia: Focus on the Mining Industry

The Australian mining has a significant impact on the environment resulting from their business activities (Adler et al., 2017; Miklosik and Evans, 2021). Australia's mining industry accounted for 8.7% of Australia's GDP in 2019 (Jang and Topal, 2020). Over 80% of Australia's minerals have yet to be explored with lithium, cobalt and nickel all crucial minerals for future renewable energy production (AusIMM, n.d.). Many negative externalities on the environment exist from current mining operations including land degradation, biodiversity loss and greenhouse gas emissions (Adler et al., 2017; Miklosik and Evans, 2021). Therefore, disclosing environmental impacts are critical to how mining companies manage and reduce their environmental footprint for the short and long-term future.

Mining companies recognise that media and public attention around possible negative environmental impacts can adversely affect their corporate reputation and trust. The idea of a social license is unique to industries like mining (Miklosik and Evans, 2021) Social licence relates to the ongoing acceptance of a company or industry's operating procedures and standard business practices by stakeholders (Nelson, J., 2006). Public awareness around the impacts from mining companies has only further elevated the need for high environmental monitoring in natural resource industries (Prno and Slocombe, 2012). Therefore providing, environmental sustainability information resulting from these increased public expectations can drive innovation towards improving their current environmental performance (Miklosik and Evans, 2021).

2.3.1 Existing Policies and Regulations that Inform Mining Environmental Disclosure Reporting in Australia

Frameworks have been previously established in Australia to improve the quality and transparency of sustainability activities and reporting for mining companies. *The Leading Practice Sustainable Development Program for the Mining Industry* published a guide on how sustainable development could be further integrated into the mining industry (Department of Industry, Science and Resources, 2011). However, there was no legal requirement for mining companies to report on sustainability issues, making it difficult for widespread adoption and compliance. Global mining-specific frameworks, like the 'Towards Sustainable Mining' (TSM) standard have also been established – encompassing site-level reporting with external verification (Towards Sustainable Mining, 2022). TSM was an opt-in framework that is only mandatory for members that are part of the Minerals Council Australia, limiting its capacity to be enforced across the broader mining industry.

More recently the Australian Accountability Sustainability Reporting Standards (ASRS) established the 'Australian Accounting Standards Board S2 Climate-related Disclosures' requiring an entity to disclose information about climate- related risks and opportunities affecting their cash flow (Australian Accounting Standards Board [AASB], 2024). These reporting standards are not just

required by mining corporations but for all Australian corporations that fit the criteria set by the ASRS (AASB, 2024). However, this style of disclosure framework is still framed within the context of financial reporting, which differs from the aims of this research. Gaps remain with streamlined, mandatory reporting frameworks for the Australian mining industry, enabling companies to voluntarily report on topics that can be easily reported and improve their environmental standing (Adler et al., 2017).

2.3.2 Previous Research around Mining Environmental Disclosure-Performance

Previous research provided context on the quality and scope of mining company disclosures. Miklosik and Evans (2021) investigated how companies disclosed on topics related to the environment. Keyword content analysis and company value was correlated for mining companies listed on the Australian Stock Exchange, suggesting that the intensity of environmental topics increases with the size of the company. Additional research provided further insight into how mining companies are advised to structure their disclosures in conjunction with government and industry frameworks (Sarker and Munro, 2015).

2.4 Research Gap and Study Rationale

The literature review revealed several important gaps, and research needs that informed the design and focus of the current study:

- Understanding how sustainability disclosure reporting is an emerging area of corporate governance, with companies seeing the value in enhancing their transparency and trust by providing non-financial information related to their activities.
- The lack of mandatory disclosure standards attributed to inconsistent environmental sustainability reporting (Carvajal and Nadeem, 2023; Khan et al., 2021). Material topics are often neglected in sustainability reporting processes by companies if they will reflect negatively on the company (Carvajal and Nadeem, 2023).
- Challenges persist for both evaluating the quality of environmental sustainability disclosures, and for assessing the disclosure-performance relationship for environmentally impactful industries like mining.

These gaps position this current study towards analysing the disclosure-performance relationship with material topics that capture relevant environmental impacts common in the Australian mining industry. Measuring disclosures that are material to the company is crucial to uncovering gaps in their reporting processes. The lack of effective globally accepted standards for sustainability reporting (Dilling, 2010), creates uncertainty about what structure and disclosures companies should adhere to (Milne and Gray, 2012). Inconsistencies can arise when comparing differences in company environmental sustainability outcomes across the industry (Pizzi et al., 2024).

Previous research suggested that companies primarily engage in sustainability disclosure and reporting for their own self-interest (Roszkowlska-Menkes et al., 2024; Brown et al., 2009). Findings by Roszkowlska-Menkes et al. (2024) revealed that 69% of negative sustainability events for companies were reported selectively, choosing to neglect glaring environmental issues for their benefit. Hence, this study uncovers whether the intention by companies for providing environmental disclosures is focused on genuine improvements towards their environmental performance.

Integrating a sector-specific framework like the GRI Disclosure Standard addresses the materiality aspect of the disclosure quality analysed for determining the disclosure-performance relationship of sampled Australian mining companies. Closely aligning the material impacts evident for companies in the mining industry assists in uncovering thematic differences disclosure reporting between high and low performing companies. This kind of research will enable investors and stakeholders to gain greater clarity around whether disclosure is a true reflection of the corporation's environmental sustainability intentions and performance. Furthermore, the structure and approach of this research has the capacity to be replicated across other industries in Australia and globally.

Chapter 3: Methodology and Methods

3.1 Thesis Roadmap

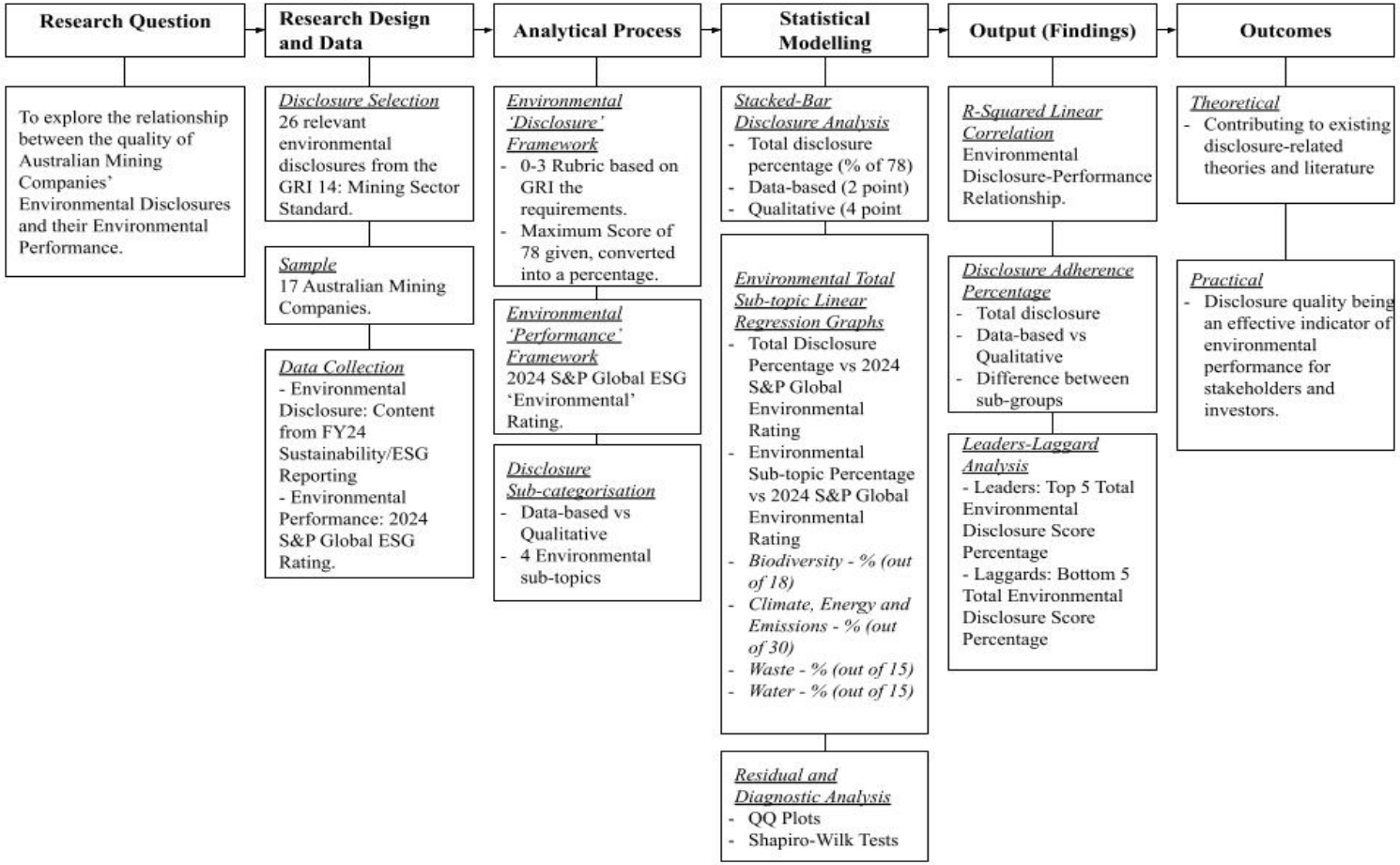

Figure 2: Thesis Roadmap.

3.2 Research Paradigm and Approach

The methodology section presents how this study addresses both research questions:

1. How does the quality of environmental disclosure adherence vary among Australian mining companies?
2. How does the quality of environmental disclosure adherence vary across material environmental sub-topics, as defined by the GRI Disclosure Standards?

Interpretive research was deployed to evaluate the environmental disclosures of mining companies from their sustainability data. Effectively interpreting the quality of environmental disclosures was crucial, given that a large percentage of accessible sustainability data is reported - varying significantly in quality, completeness, and comparability (Eng et al., 2022; Herbohn et al., 2014).

Content analysis was the primary method for interpreting the quality of sustainability disclosures and data provided by the sampled mining companies. Content analysis organises and draws meaning from the data collection where realistic conclusions can be made (Bengtsson, 2016). A set score criterion for the content analysis ensured the quality and depth of the environmental disclosure for each company was interpreted effectively (Miklosik and Evans, 2021). Scoring the quality of environmental disclosures by the mining companies enabled the original qualitative reporting data to be transformed into comparable quantitative results (Bengtsson, 2016), towards uncovering the relationship between the quality of environmental disclosure and their environmental performance.

The methodological approach for this research involved a five-step process:

1. The first step established the parameters for content selection:

   - Medium: Publicly accessible electronic documents found on the internet.

   - Genre: Relevant environmental sustainability data.

   - Inclusion criteria: 2024 Financial Year Sustainability Report and Performance Data

   - Sample: ASX Australian mining companies (headquarters located in Australia)

2. The second step defined the disclosures that would be scored for the Disclosure Score Framework:

   - 26 GRI Disclosure Standard 'Likely Topics' were selected. These topics were also allocated to one of four specific environmental sub-topics: Climate, Energy and Emissions; Biodiversity; Water; and Waste.

3. The third step determined 0-3 scoring criteria based on how well the provided disclosure adhered to the GRI disclosure requirements from step 2. The scoring criteria was adapted from other criteria found in similar disclosure-performance research

articles (Ching et al., 2013; Morhardt et al., 2002; Rüger and Maeterns, 2023; Yadava and Sinha, 2015).

4. The fourth step applied the scoring criteria each company based on the quality of disclosure found within their sustainability reporting. This was repeated for all 26 disclosures. The reasoning behind the allocation of each individual disclosure score was provided, found in Appendix 2: Example of Disclosure Company Scoring Table.
5. The fifth step utilised statistical analysis to determine the relationship between the individual mining company's score from the GRI Disclosure Score (in step 4) and their Performance Score. Further statistical analysis showcased the disclosure adherence rates and correlation for each of the environmental sub-topics.

3.3 Selection Process of 'Material' Environmental Disclosures chosen for the Study

The process behind the selection of environmental disclosures for this research encapsulated the environmental impacts and externalities that are common in the Australian mining industry. Unlike other research which compiled common disclosures and indicators from a wide range of literature and reporting guidelines (Miklosik and Evans, 2021; Papoutsi and Sodhi, 2020), the priority was selecting disclosures within the same voluntary framework to promote uniformity and enhance the comparability of the results.

The GRI Disclosure Standard was chosen as the framework for selecting the disclosure and the disclosure requirements for the analysis (GRI, 2021). The GRI framework is designed to provide a more complete reporting basis of a wider range of impacts beyond just financial outcomes (Morhardt et al., 2002), appropriately aligning with the research aims and questions of this study. As this disclosure-performance analysis only focused on environmental topics related to mining, the economic and social topic disclosures were removed. There was a substantial body of previous research that had applied earlier GRI frameworks to assess corporate sustainability performance (Belkhir et al., 2017; Ching et al., 2013; Laskar, 2024; Morhardt et al., 2002; Rüger and Maeterns, 2023; Yadava and Sinha, 2015). Therefore, this study could be aligned with an existing body of knowledge related to the disclosure-performance relationship by utilising updated GRI standards that is directly related to the Australian mining industry.

26 disclosures were chosen from this standard. Each disclosure was also manually allocated into one of four sub-topics (Climate, Energy and Emissions; Biodiversity; Water; Waste) to assist with analysing gaps between different environmental topic reporting quality amongst the Australian mining industry. The chosen GRI disclosures is seen below in Table 1 with the GRI requirement criteria for each disclosure attached in the Appendix 1: GRI 14: Mining Sector Disclosure Requirements.

Table 1: The 26 Disclosures chosen from the GRI Disclosure Standard.

GRI Standard	GRI Disclosure	Sector Standard Ref #	*Allocated 'Disclosure Sub-Topic'*
GRI 101: Biodiversity 2024	101-1 Policies to halt and reverse biodiversity loss	14.4.1	*Biodiversity*
GRI 101: Biodiversity 2024	101-2 Management of biodiversity impacts	14.4.3	*Biodiversity*
GRI 101: Biodiversity 2024	101-4 Identification of biodiversity impacts	14.4.4	*Biodiversity*
GRI 101: Biodiversity 2024	101-5 Locations with biodiversity impacts	14.4.5	*Biodiversity*
GRI 101: Biodiversity 2024	101-6 Direct Driver of biodiversity loss	14.4.6	*Biodiversity*
GRI 101: Biodiversity 2024	101-7 Changes to the state of biodiversity loss	14.4.7	*Biodiversity*
GRI 305: Emissions 2016	305-4 GHG emissions intensity	14.1.8	*Climate, Energy and Emissions*
GRI 305: Emissions 2016	305-5 Reduction of GHG emissions	14.1.9	*Climate, Energy and Emissions*
GRI 305: Emissions 2016	305-7 Nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions	14.3.2	*Climate, Energy and Emissions*
GRI 201: Economic Performance 2016	201-2 Financial implications and other risks and opportunities due to climate change	14.2.2	*Climate, Energy and Emissions*
GRI 306: Waste 2020	306-1 Waste generation and significant waste-related impacts	14.5.2	*Waste*
GRI 306: Waste 2020	306-2 Management of significant waste-related impacts	14.5.3	*Waste*
GRI 306: Waste 2020	306-3 Waste generated	14.5.4	*Waste*
GRI 306: Waste 2020	306-4 Waste diverted from disposal	14.5.5	*Waste*
GRI 306: Waste 2020	306-5 Waste directed to disposal	14.5.6	*Waste*
GRI 303: Water and Effluents 2018	303-1 Interactions with water as a shared resource	14.7.2	*Water*
GRI 303: Water and Effluents 2018	303-2 Management of water discharge-related impacts	14.7.3	*Water*
GRI 303: Water and Effluents 2018	303-3 Water withdrawal	14.7.4	*Water*
GRI 303: Water and Effluents 2018	303-4 Water discharge	14.7.5	*Water*

3.4 Construction of Disclosure Framework Scoring Criteria

A consistent scoring criterion was constructed to evaluate the quality and depth of disclosures found from mining company's environmental 2024 sustainability data. A scoring criterion of 0-3 was seen as the most representative to this style of research, going beyond a presence-absence (0-1) criterion. This criterion hoped to distinguish between companies that provide detailed, transparent, and comparable sustainability disclosures with companies that lag and have gaps in their disclosure reporting. Jonsson and Svingby (2007) highlight that rubrics or criterions makes expectations and criteria explicit, improving the reliability of performance assessments in research literature.

Table 2: Adapted Scoring Criteria for Disclosures.

Score	Criteria
0	Disclosure not mentioned in report and/or disclosure requirement not met
1	Brief coverage of Disclosure. Minimal alignment with the GRI listed disclosure requirements
2	More in-depth coverage of Disclosure. Moderate alignment with the GRI listed disclosure requirements
3	Complete coverage of Disclosure. Full alignment with the GRI listed disclosure requirements including, where relevant, actions to manage the disclosure

3.5 Sample of Selected Australian Mining Companies

The sample was selected using a combination of purposive and pragmatic criteria. Mining companies were purposively selected from the Australian Stock Exchange (ASX) based on two criteria:

1. Having publicly accessible sustainability data (including reports and performance tables) from the 2024 financial year.
2. Having a publicly accessible 2024 S&P Global ESG 'Environmental' Score.

31 metal and mining companies met the first eligibility criteria of being listed on the ASX and having publicly accessible sustainability data (including reports and performance tables) from the 2024 financial year. All companies in this sample have a headquarter office in Australia despite some companies having mining sites overseas. From the initial 31 companies, only 17 of these companies also had a Performance score accessible on the S&P Global website, with the final sample of companies listed in Table 3. The 14 companies that did not have publicly accessible ratings on the S&P Global website were excluded from the analysis.

Table 3: Selected ASX Metals and Mining Companies.

ASX Metals and Mining Company	S&P Global Industry Classification
Northern Star	Metals and Mining (MNX)
South32 Limited	Metals and Mining (MNX)
Evolution Mining	Metals and Mining (MNX)
Sandfire Resources Limited	Metals and Mining (MNX)
Mineral Resources Limited	Metals and Mining (MNX)
Perseus Mining	Metals and Mining (MNX)
Regis Resources	Metals and Mining (MNX)
Ramelius	Metals and Mining (MNX)
Gold Road Resources	Metals and Mining (MNX)
Emerald Resources	Metals and Mining (MNX)
Iluka Resources	Metals and Mining (MNX)
Bellevue Gold Limited	Metals and Mining (MNX)
Liontown Resources	Metals and Mining (MNX)
Lynas Rare Earths	Metals and Mining (MNX)
Genesis Minerals	Metals and Mining (MNX)
Capricorn Metals	Metals and Mining (MNX)
Chalice Mining	Metals and Mining (MNX)

The 2024 S&P Global ESG Environmental Score was used as the environmental performance metric to be compared against the environmental disclosure scores derived from the disclosure scoring process. S&P Global was selected as the framework for the environmental 'performance' score of this analysis. A sufficient number of Australian mining companies were publicly available to be used that made the analysis feasible and representative. Other publicly available ESG measures were considered, such as Sustainalytics (Morningstar, 2025) and MSCI ESG Ratings (MSCI, 2025) to incorporate as the environmental 'performance' score. However, these measures did not offer the same degree of coverage of Australian mining companies. There were limited detail and transparency to how their ratings were weighted and calculated compared to S&P Global.

A score out of 100 was determined for each company based on measuring the environmental material risks, opportunities and impacts informed by company disclosures, modelling approaches and in-depth company engagement through their corporate sustainability assessment (S&P Global, 2025).

3.6 Data Collection and Analysis

Content analysis was the primary method utilised for assigning the appropriate disclosure scores for each of the 17 Australian companies' environmental sustainability information and data. Initially, the disclosure scores were recorded for two companies by myself (Sandfire Resources Limited and Evolution Mining) which were then cross-checked with my Honours supervisor Sarah Clement. Cross-checking was used to ensure the scoring process is consistent, quickly detecting any errors that may jeopardise or negatively impact the outcome of the quality of the analysis and reliability of the findings (Patterson et al., 2007). It was not feasible for the scores to be cross-checked for the whole sample. During the cross-checking process due to the time constraints of submitting this thesis. There were no significant discrepancies between Sarah and my score evaluations for the two companies. Incorporating this cross-checking process ensured that a consistent scoring process was established and could be replicated effectively for the remaining 15 companies in the study sample.

NVivo 15, a leading qualitative data analysis software assisted in the categorisation and 'housing' of the environmental sustainability data of the mining companies (Lumivero, 2025). However, the allocation of scores were still completed manually and guided by the specific disclosure requirements provided by the GRI Disclosure Standard requirements in Appendix 1: GRI 14: Mining Sector Disclosure Requirements**.** The 26 disclosure scores given for the specific company were added together to form a final 'Total Disclosure score' out of 78. The score of 78 was subsequently converted to a percentage score out of 100 as the Performance score by S&P Global is also rated out of 100.

3.6.1 Percentage Distribution and Categorisation of Disclosures

For the statistical analysis, percentage distribution charts were created to showcase the spread and frequency in scoring of 0, 1, 2 and 3 for each of the 26 disclosures from the sample. Analysing the frequency in scores highlighted gaps in material topic disclosure reporting across the mining industry. A high concentration of 3 scores showcased completeness for the disclosure where there is highly consistent reporting whilst disclosures. Meanwhile high frequencies of 0 and 1 scores uncover which topics are poorly neglected or addressed.

3.6.2 Environmental Disclosure-Performance Relationship

Descriptive statistics were calculated to showcase the variation in data of the sampled companies' total disclosure percentage. The mean, median and standard deviation were determined for the descriptive statistical summary. The mean represented the average level of environmental disclosure percentage and performance ratings out of 100, offering an insight to the overall quality of the sample. The median accounted for the potential skewness in the data, providing a central indicator that is less influenced by outlier values. The standard deviation captured the degree of variation in total environmental disclosure and the four disclosure sub-topics and whether there was consistency of scores across the sample.

Simple linear regression was applied to plot the x axis 'Total Disclosure Score Percentage' with the y axis '2024 S&P Global Environmental Performance Score' to showcase the disclosure-performance relationship. This process was subsequently repeated for each of the four disclosure sub-topics in the GRI allocated from the 26 disclosures. This helped determine if any differences in disclosure-percentage adherence between the specific environmental topic.

- *Biodiversity: 6 Disclosures (maximum score of 18)*
- *Climate, Energy and Emissions: 10 Disclosures (maximum score of 30)*
- *Waste: 5 Disclosures (maximum score of 15)*
- *Water: 5 Disclosures (maximum score of 15)*

Score percentage (%) was used instead of the raw data scores for all statistical analyses. This was to enable easier interpretation and comparability across each environmental sub-topic given there was not an equal number of disclosures with each sub-topic. Residuals and QQ plots were incorporated for all linear regression plots to showcase the normality and homoscedasticity across the sample. As the sample size was relatively small, it was noted that the increased sensitivity of outliers can weaken the statistical significance of the results (Osborne and Overbay, 2004). My approach to the statistical analysis was assisted by Alice Richardson from the ANU Statistical Support Network, ensuring the analysis aligned with the research aims of this thesis.

3.6.3 Early Adopter-Laggard Analysis

This methodological process and subsequent analysis set up a qualitative leader-laggard comparative analysis to understand variation in disclosure quality. This analytical approach, commonly used in sustainability disclosure research (Hahn and Kühnen, 2013; Hahn et al., 2018, Clarkson et al., 2008), enabled comparison between high and low performers. Companies were categorised based on their total disclosure scores, with reference to Rogers (1962) 'adopter categories':

- The top five scoring companies (% score from the GRI Disclosure Standard) were classified as *'Early Adopters'*.
- The bottom five (% score from the GRI Disclosure Standard) were classified as *'Laggards'*.

Further investigation into the environmental disclosure and data information from the 'early adopter' and 'laggard' companies, using thematic analysis to determine what constitutes high-quality and low-quality environmental disclosures from the disclosures provided by the GRI Disclosure Standard. Thematic analysis can be defined as a qualitative descriptive method for identifying, analysing and reporting patterns within data (Vaismoradi et al., 2013). Applying thematic analysis to compare the environmental disclosures of companies from the two different adopter categories allowed meaningful insights and trends to be extracted from disclosure-performance relationship analysis.

Chapter 4: Results

4.1 Disclosure Scoring Percentage Distribution

4.1.1 All Disclosures

Disclosure adherence varied widely across environmental topics, with water and emissions consistently well-reported but biodiversity severely underreported, seen in Figure 3**.** Only two disclosures recorded no scores of 0 across the sample. These were Disclosure '303-1 Interactions with water as a shared resource' and '303-2 Management of water discharge-related impacts'.

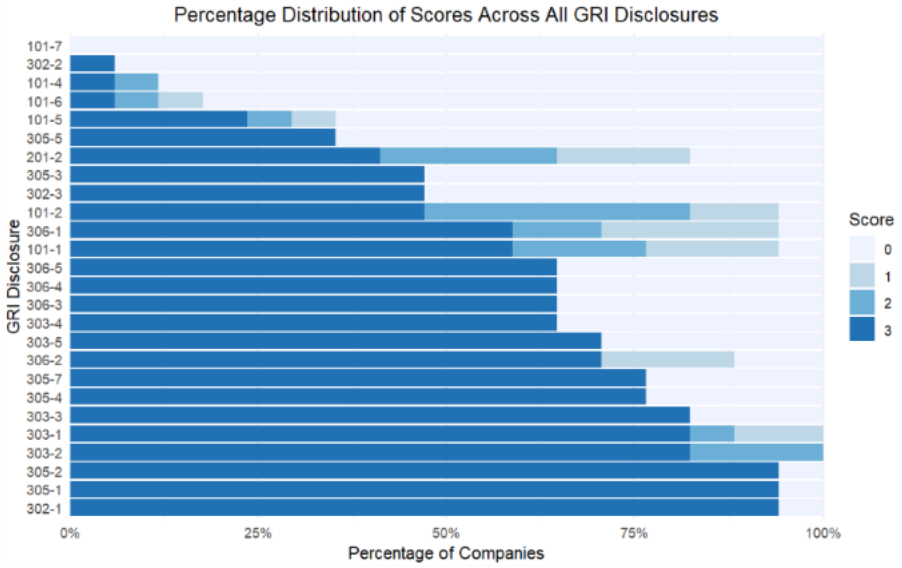

Figure 3: Percentage Distribution of Scores Across All GRI Disclosures.

The disclosures with the highest frequency of scores of 3 (complete adherence) were all data-based 'two-point' disclosures (305-2, 305-1 and 302-1). These were all related to emissions and energy consumption totals produced by the company. This type of reporting can be relatively straightforward to quantify and track given the numeric nature of these disclosures, which can be effectively standardised and comparable across the mining industry.

Only one disclosure 'Changes to the state of biodiversity' (101-7) received zero scores across all companies, whilst there were also an additional three biodiversity disclosures in the bottom five lowest adhered to disclosures. Boiral (2016) depicts how complexity, uncertainty and opacity of biodiversity reporting can cause companies to briefly focus on biodiversity reporting for the impression management and symbolic purposes. This issue stems from the disconnect between sustainability reporting practice and actual ecological protection, where techniques of neutralisation makes it difficult for stakeholders to verify their biodiversity commitments from their reporting (Boiral, 2016)

4.1.2 Data-based (Two-Point) Disclosures

There was a trend towards two clear groups of disclosure scores from the scoring percentage distribution seen in **4.1.1**. It was observed that disclosures that incorporated the requirements of data or numeric information were scored like a 'binary' presence-absence system. This was in the case that disclosures incorporated numerical and measurable evidence related to the specific environmental topic. A score of 3 could be seen when the numeric data was present whilst a score of 0 was evident if the data was absent. Thus, there was no capacity to allocate a score of 1 or 2 for these disclosures given there was no intermediate level for data-based disclosures from the scoring criteria that was used.

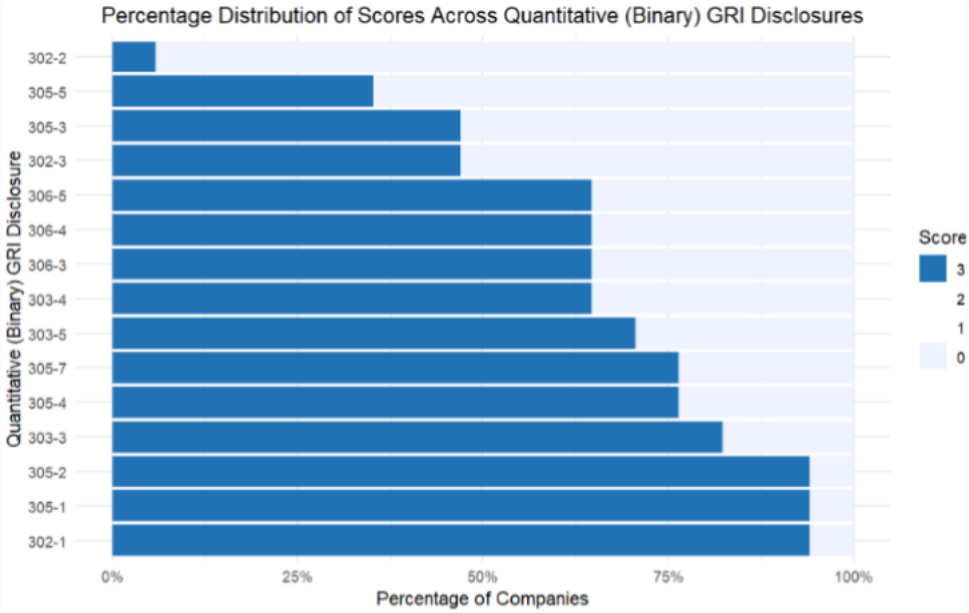

Figure 4: Percentage Distribution of Scores Across Quantitative (Binary) GRI Disclosures.

The benefit of distinguishing data-based disclosures appropriately captured the differences in percentage adherence for disclosures linking measurable evidence with current their environmental performance. Seven out of the eleven disclosures had over 50% of the sampled companies exhibit full disclosure found within their sustainability reporting. The three most adhered to disclosures (305-2 Energy Indirect [Scope 2] GHG Emissions, 305-1 Energy Direct [Scope 1] GHG Emissions and 302-1 Energy consumption within the organisation), which all fall under the Climate, Energy and Emissions sub- group, had the highest adherence rate of 94% as mentioned in **4.1.1**.

4.1.3 Qualitative (Four-Point) Disclosures

The disclosures that had a distinct focus on interactions, management and impacts were classified as qualitative four-point disclosures. There was no specific requirement for these disclosures to include numeric data as measurable evidence for the specific environmental disclosure in question. As these disclosures require interpretation of narrative information to determine the adherence to the specific disclosure criteria there was the capacity for disclosures to partially meet the requirements. Therefore, there were 11 disclosures had the capacity to be scored a 0, 1, 2 and 3 depending on the level of adherence.

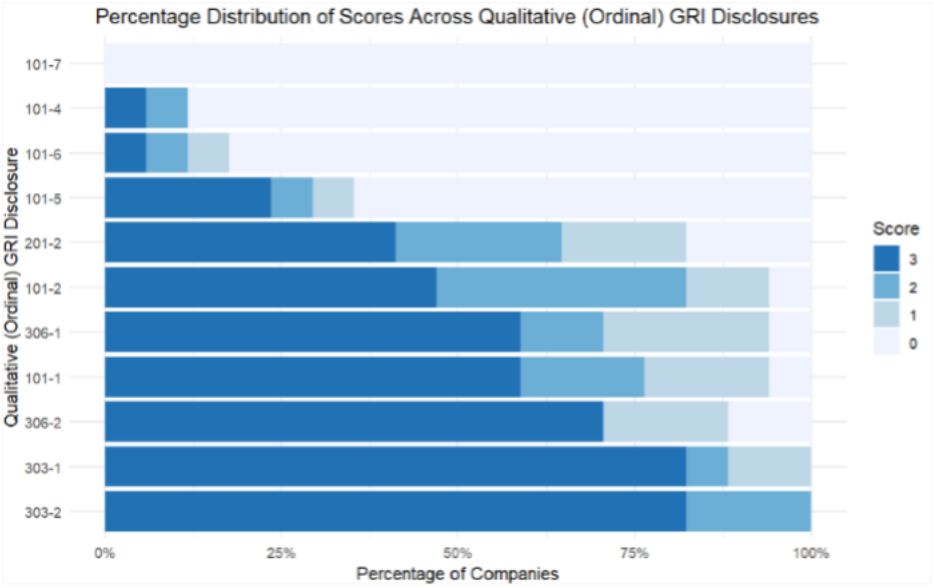

Figure 5: Percentage Distribution of Scores Across Qualitative (Ordinal) GRI Disclosures.

Classifying qualitative-based disclosures depicted which disclosures by companies best contextualised their environmental information in a manner that accurately conveyed the environmental impacts stemming from their operations. The four lowest disclosure score percentages were all related to biodiversity (101-7 ‘Changes to the state of biodiversity, 101-4 ‘Identification of biodiversity impacts’, 101-5 ‘Locations with biodiversity impacts’, 101-6 ‘Direct Drivers of biodiversity loss). All the companies achieved at least a minimum of 1 for the remaining qualitative disclosures, attaining at least an 82% percentage adherence. This implied that mining companies made at lease some communicate their environmental interactions and management strategies related to their mining activities.

4.2 Total Disclosure-Performance Relationships

4.2.1 Descriptive Statistics

Table 4: Descriptive Statistics of Total Disclosure Percentage (/78).

Environmental Disclosure Framework Sub-topic	Maximum	Minimum	Mean	Median	Standard Deviation
Total Disclosure Percentage (/78)	79%	8%	60%	67%	19%

Total disclosure scores showed substantial variation across companies, ranging from 8% to 79%, with a mean of 60% and median of 64%. The negative skew (mean < median) indicates that while most companies achieved moderate-to-high disclosure scores, a few extreme low performers pulled down the average. The large standard deviation of 19% confirms considerable heterogeneity in disclosure quality, suggesting some companies disclosed comprehensively while others had significant gaps.

4.2.2 Total Disclosure-Performance Simple Linear Regression

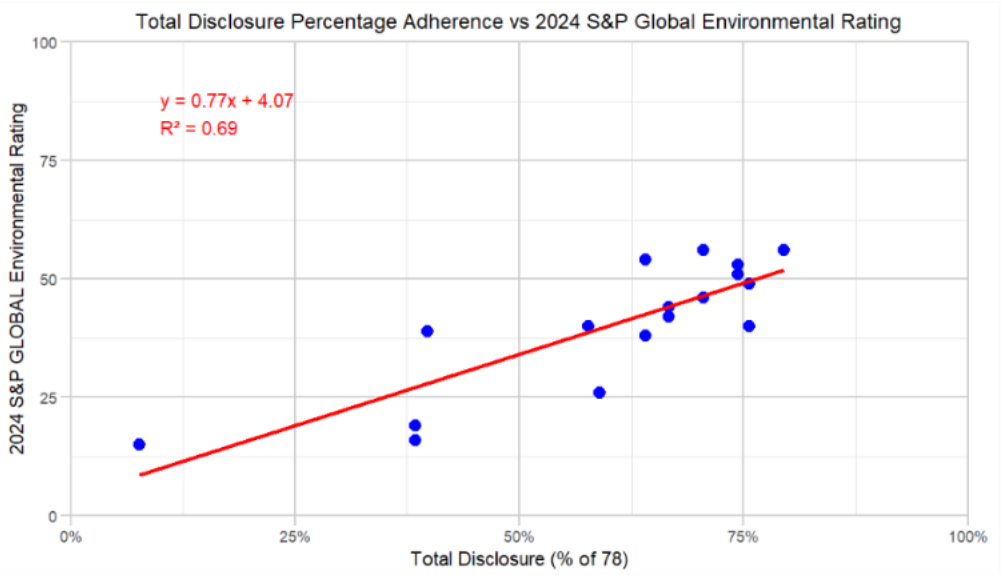

Figure 6: Total Disclosure-Performance Simple Linear Regression Graph.

Environmental disclosure quality was strongly associated with environmental performance ratings ($R^2 = 0.69$, $p < 0.001$). Companies with higher disclosure scores correlated with a higher performance score, suggesting that the explanatory variables are statistically significant (Ozili, 2023). This indicated that 69% of the variation in environmental performance ratings can be explained by the disclosure quality provided by the sample.

4.3 Sub-Topic Disclosure: Descriptive Statistics and Linear Regression

In addressing RQ 2, the analysis highlighted where mining companies demonstrated stronger or weaker reporting practices depending on the environmental sub-topic in question. The 26 sub-topic disclosures were broken down into:

- Biodiversity
- Climate, Energy and Emissions
- Waste
- Water

4.3.1 Biodiversity

Table 5: Descriptive Statistics of the Biodiversity Score Percentage (/18).

Environmental Disclosure Framework Sub-topic	Maximum	Minimum	Mean	Median	Standard Deviation
Biodiversity Score Percentage (/18)	83%	0%	40%	40%	17%

Biodiversity disclosures were the lowest environmental sub-topic that was adhered to with the GRI disclosure framework. A mean percentage adherence of 40% was 23% lower than the next lowest sub-topic, whilst also having a low median percentage adherence of 40%. Biodiversity disclosures due to the complexity and ecological differences seen from mine site to site, it can present challenges for companies to compile consistent disclosures that meet the expected requirements. (Boiral, 2016; Bhattacharyya and Yang, 2019).

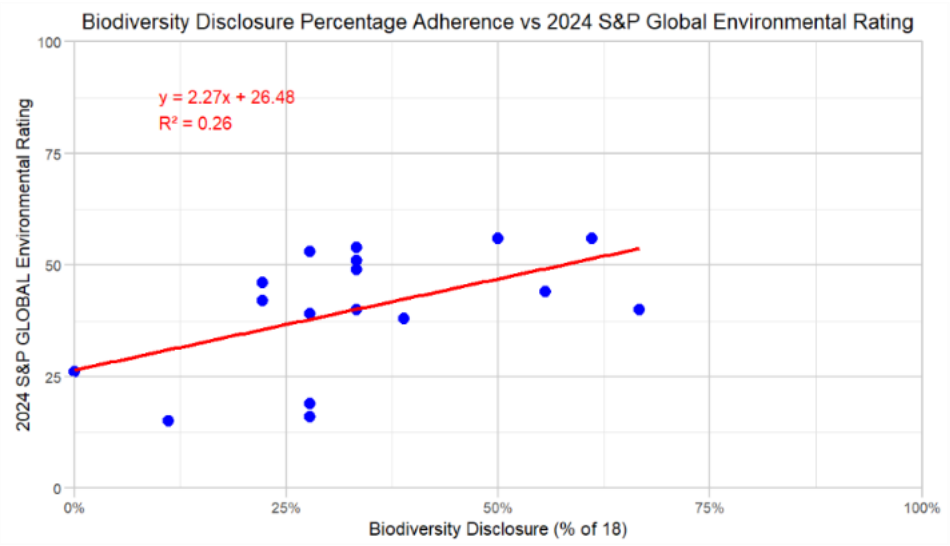

Figure 7: Biodiversity Disclosure-Performance Linear Regression Graph.

The biodiversity sub-topic presented the most inconsistent linear regression graph out of the four sub-topics. A regression squared of 0.26 indicated a weak positive relationship between biodiversity disclosure and their performance score. The scatter of data points is greater, suggesting that biodiversity disclosure is not a decisive explanatory driver for determining their environmental performance. The difficulty of providing consistent and comparable biodiversity disclosures across companies could be a reason behind this weak correlation.

4.3.2 Climate, Energy and Emissions

Table 6: Descriptive Statistics of Climate, Energy and Emissions Disclosure Percentage.

Environmental Disclosure Framework Sub-topic	Maximum	Minimum	Mean	Median	Standard Deviation
Climate, Energy and Emissions Score Percentage (/30)	80%	0%	63%	70%	20%

The Climate, Energy and Emissions sub-topic had the second lowest percentage adherence despite having the most disclosures out of all sub-topics. A mean percentage adherence of 63% and median percentage adherence of 70%, whilst having a standard deviation percentage of 20%. The global movement towards decarbonisation, elevated through legislation, points companies towards emission and energy reporting that can be tracked moving forward (AASB, 2024). Therefore, there was high emphasis by companies to disclose physical and transitional risks surrounding their current carbon footprint and the impact from climate change (Arena et al., 2025)

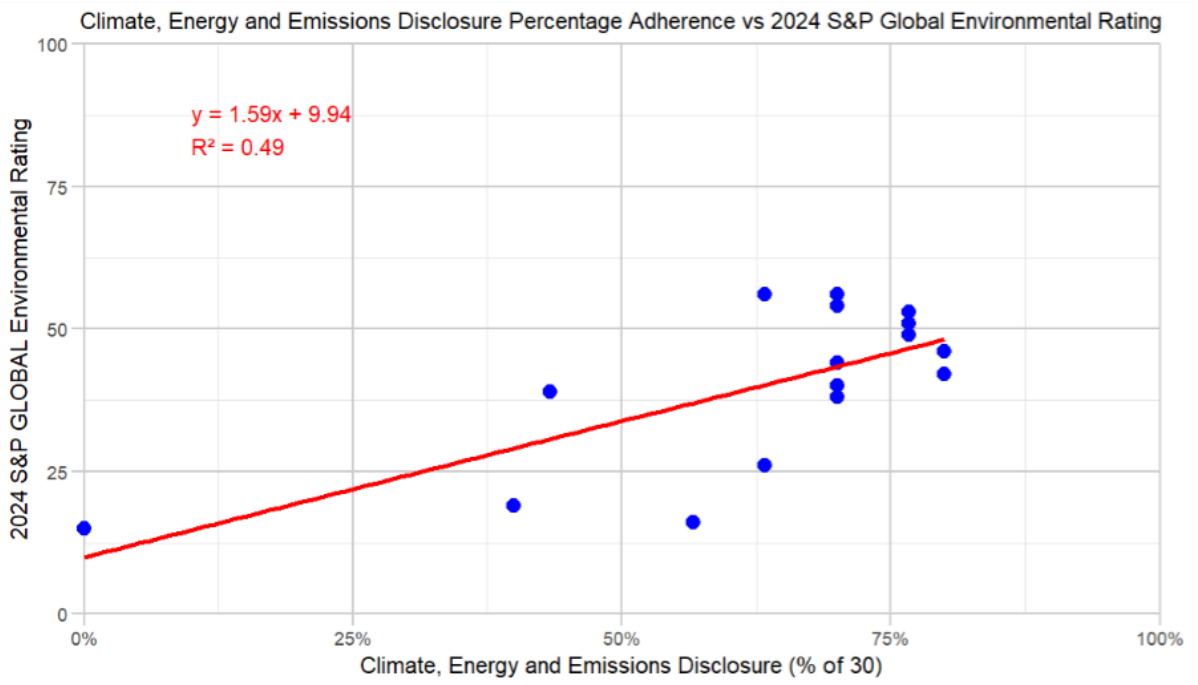

Figure 8: Climate, Energy and Emissions Disclosure-Performance Simple Linear Regression.

Climate, Energy and Emissions had a moderately positive relationship between company disclosure and performance scores, with a r squared of 0.49. A clustering for companies was seen around the high-disclosure range, with greater variability for companies with lower disclosure scores. For the lower disclosure companies, it raises whether Climate, Energy and Emission disclosures are not a prolific factor in the calculation of their performance score. Climate risks are often long-term, which may not affect the rating of a company for their rating at the present time (Arena et al., 2025; Harasheh et al., 2024).

4.3.3 Waste

Table 7: Descriptive Statistics of Waste Score Disclosure Percentage (/15).

Environmental Disclosure Framework Sub-topic	Maximum	Minimum	Mean	Median	Standard Deviation
Waste Score Percentage (/15)	100%	20%	65%	73%	34%

Waste was relatively well-disclosed by the sample mining companies, with an average and median percentage adherence of 65% and 73% respectively. However out of all the sub-groups had the highest standard deviation percentage, suggesting that the sample score percentages had the highest variability out of all the sub-topics.

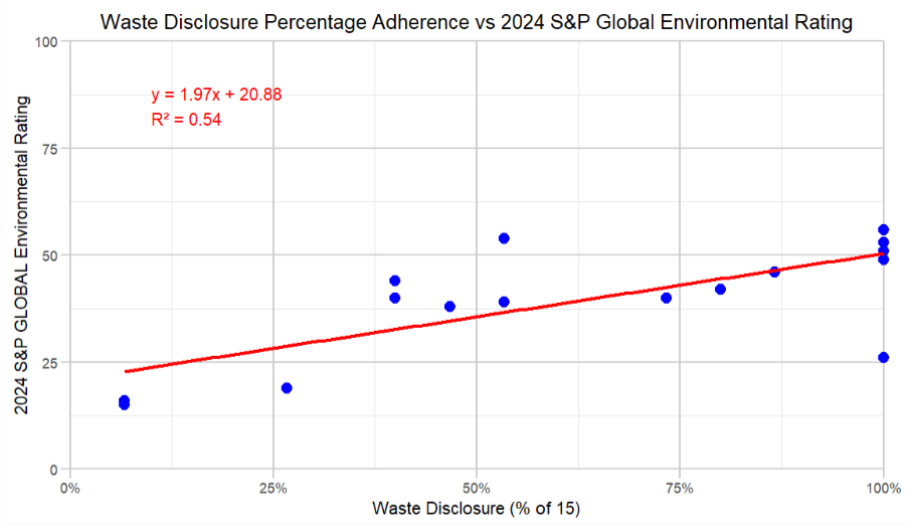

Figure 9: Water Disclosure-Performance Simple Linear Regression

The Waste disclosure linear regression graph showcased a moderately positive relationship, with relatively even homoscedasticity for points on either side of the regression line. The regression squared provided a value of 0.54, suggesting that the explanatory power of waste disclosures is the most likely out of all environmental sub-topics to indicate the company's environmental performance.

4.3.4 Water

Table 8: Descriptive Statistics for Water Score Percentage (/15).

Environmental Disclosure Framework	Maximum	Minimum	Mean	Median	Standard Deviation
Water Score Percentage (/15)	100%	7%	80%	93%	26%

The water sub-topic obtained the highest environmental sub-topic average and median out of the four environmental sub-topics. The mean percentage adherence was 80% and the median percentage adherence was 93%, with outliers by low-performing companies causing a negative skewness. A standard deviation percentage was also the second highest out of the four sub-topics, with a variability of 26%.

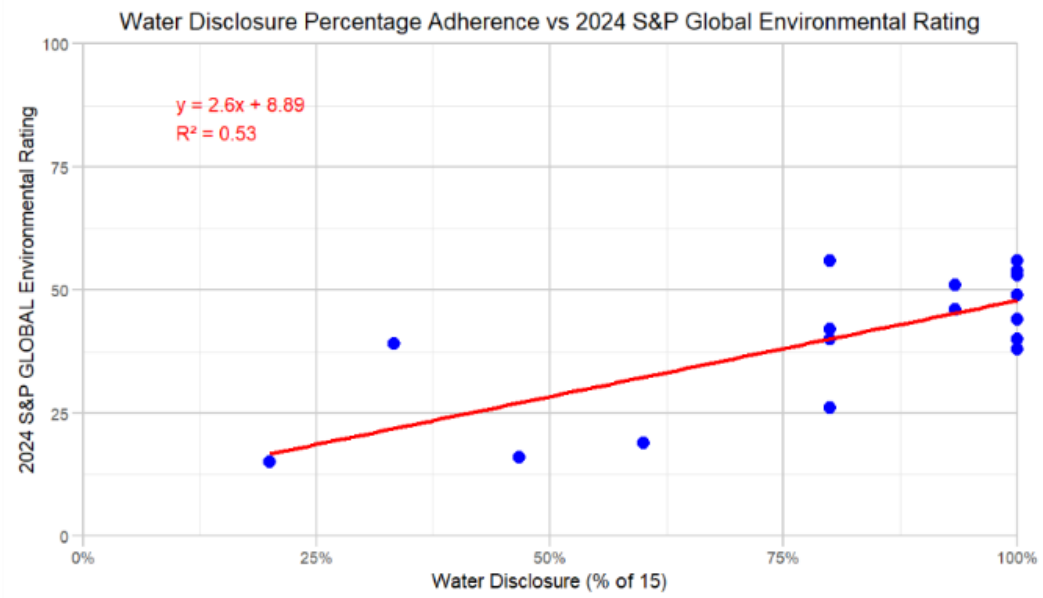

Figure 10: Water Disclosure-Performance Simple Linear Regression Graph.

The linear regression presented a moderately strong relationship between company waste disclosure percentage adherence and their environmental rating. A moderate regression squared of 0.53 was found, with similar variance of points above and below the regression line. Given the prominence of water as an environmental topic in the mining sector, greater emphasis is likely attributed to these disclosures being weighted more heavily to their performance score.

4.4 Early Adopter–Laggard Analysis

Table 9: Top 5 and Bottom 5 Company Total Disclosure Score Percentage.

Company	**Total Disclosure Score Percentage**	**S&P Global Environmental ESG Rating (/100)**
Top 5		
Evolution Mining	79%	56
Northern Star	76%	49
Bellevue Gold Limited	76%	40
Perseus Mining	74%	51
Iluka Resources Limited	70%	46
Average	*60%*	*48*
Bottom 5		
Genesis Minerals	8%	15
Emerald Resources	39%	19
Capricorn Metals	45%	16
Chalice Mining Lithium	45%	39
Lynas Rare Earths	58%	40
Average	*39%*	*25.8*

An early adopter-laggard analysis was undertaken with a specific focus to answering RQ 1, identifying trends that distinguish companies that provide highly detailed and comprehensive environmental disclosures 'early adopters' from those with absent or weaker disclosure reporting 'laggards'. This analysis incorporated two of the 'adopter categories' detailed by Rogers (1962), which were utilised in recent research (Ediriweera and Wiewiora, 2021). Furthermore, identifying these differences can help inform regulators and policymakers around what constitutes high- and low-quality reporting based on the disclosure requirements from the *GRI 2024: Mining Sector* standard.

4.4.1 Size of Market Capitalisation Influencing the Quality of Company Disclosures

Table 10: Top 5 and Bottom 5 Disclosure Score Percentage 2024 Market Cap.

Company	**Total Disclosure Score Percentage**	**InvestingPro June 30 2024 Market Cap (AUD)**
Top 5		
Evolution Mining	79%	$6.951B
Northern Star	76%	$13.929B
Bellevue Gold Limited	76%	$2.102B
Perseus Mining	74%	$3.228B
Iluka Resources Limited	70%	$2.802B
Average	*60%*	*$5.8024B*
Bottom 5		
Genesis Minerals	8%	$1.969B
Emerald Resources	39%	$2.316B
Capricorn Metals	45%	$1.805B
Chalice Mining Lithium	45%	$0.5523B
Lynas Rare Earths	58%	$5.543B
Average	*39%*	*$2.437B*

There is a significant difference in the market cap for the top five 'early-adopter' companies (mean of $5.8024B) and the bottom five 'laggard' companies (mean of $2.437B). Laggards having a lower market capitalisation tie to Rogers (1962) diffusion of innovation theory where the lower financial capacity for laggard companies increased their hesitancy towards adopting innovation, like environmental disclosure reporting. Meanwhile the relatively larger market capitalisation of early adopters provided these companies with the opportunity to invest in corporate environmental sustainability strategies that may exhibit have a higher degree of uncertainty towards overall business success.

Chapter 5: Discussion

Overall, the study revealed the following key findings:

- Increased environmental disclosure adherence is associated with increased environmental performance. An R-squared coefficient of 0.69 was evident between x-axis 'total disclosure percentage' and the y-axis 'performance score'. As 0.69 was above the acceptable lower bound of $R^2 > 0.5$ (Ozili, 2023), it can be suggested that the explanatory variables were statistically significant.
- Selected sampled companies based on their total disclosure percentage adherence were incorporated into the early adopter-laggard analysis, and the correlation it had with their performance score. There was a noticeable difference (mean of $2.437B) between the market capitalisation of early adopter compared to laggard companies, supported the diffusions of innovations theory by Rogers (1962) that financial size influences the capacity for companies to mitigate the uncertainty when adopting innovation.
- Topic-specific patterns reveal the gaps and priorities of mining company environmental reporting. Water and Climate, Energy and Emissions disclosures showed the greatest disclosure-performance relationships ($R^2 = 0.53$ and 0.49), while Biodiversity showed weak correlation ($R^2 = 0.26$). This suggested there is a low explanatory power for company biodiversity disclosure quality reflecting their environmental performance compared to the other environmental sub-topics.
- Disclosure quality varies substantially across companies and topics. While most companies (94%) reported emissions data, biodiversity disclosure was severely lacking, with four biodiversity disclosures scoring below 25% disclosure adherence. These findings support RQ 2, where biodiversity had a significantly lower mean percentage adherence rate (40%) that was significantly lower than the other three sub-topics of Climate, Energy and Emissions (63%), Waste (65%) and Water (80%).

Table 11: R-Squared Coefficient for each Disclosure Topic Category.

Disclosure-Performance Relationship Topic	R-squared Coefficient
Total	0.67
Biodiversity	0.26
Climate, Energy and Emissions	0.49
Waste	0.54
Water	0.53

The discussion sections below provide more in-depth analysis of the findings:

Section 5.1 addressed RQ 1 by utilising Rogers (1962) 'Adopter Categories' framework to dissect the study results. This framework analysed differences in quality of environmental disclosures seen by 'early adopters' and 'laggard' companies to determine key themes between high quality and low-quality environmental topic reporting related to the GRI Disclosure Standard. A thematic analysis was undertaken, revealing four key distinctions between early adopter and laggard companies:

- Level of Disclosure Alignment with existing government and disclosure frameworks.
- Level of Numeric Data to support environmental sustainability claims.
- Level of site-specific information disclosed.
- Size of Market capitalisation influencing the quality of disclosure provided.

Section 5.2 focused on why the scoring quality of sampled mining companies differed across material environmental topics defined by the GRI Disclosure Standard. The differences in scoring quality across the four sub-topics was investigated, with discussion centred around whether these differences exist in the context of current of current policy and disclosure landscape for Australian mining companies. Current biodiversity policies related to mining in Australia are highlighted to the lower disclosure score percentage adherence compared to the other three environmental sub-topics. As the GRI disclosure standard recommend these topic disclosures as material and are not mandatorily enforced, mining companies may have differing perceptions of what environmental topics they prioritise based on their own self-defined environmental materiality assessments.

Section 5.3 centred around the practical and theoretical implications from the findings from this study. Theoretical implications built upon existing literature based on the disclosure-performance relationship of companie by utilising adopter categories detailed by Rogers (1962) 'Diffusion of Innovations Theory'. Practical implications focused on how the study findings provide stakeholders and regulators a better understanding of company environmental disclosures quality can indicate their current environmental management practices. Limitations and future recommendations are further provided as to how this study can be improved moving forward.

5.1 RQ1: Early Adopter-Laggard Analysis

5.1.1 Degree of Disclosure Alignment with Existing Government and Disclosure Frameworks

A common theme for the 'Early adopter' mining companies was the alignment of their environmental disclosure data reporting with established government policies and voluntary framework processes. Having these disclosures formed off recognised standards demonstrated that their disclosures are not self-defined but rather validated against credible reporting benchmarks (Arena et al., 2025; Pizzi et al., 2024). Northern Star as an early adopter company, conveyed how their environmental policy was updated to align with external framework certifications like *ISO:14001* and the *Taskforce on Nature-Related Financial Disclosures (TNFD)* to certifying their approach (Northern Star Resources, 2024). Similarly, Bellevue Gold Mining aligned their sustainability reporting with the SASB, GRI and TNFD frameworks to reduce the subjectivity of their disclosure practices and providing investors and stakeholders with standardised environmental performance measures (Bellevue Gold, 2024). Aligning disclosures with established frameworks in the case that future mandatory environmental disclosure requirement being enforced in the future (Arena et al. 2025).

From a laggard perspective, some of the companies had created their own self-defined frameworks with no alignment to any recognised disclosure frameworks. Genesis Minerals titled their disclosure reporting based on a 'compliance system' – a vague title with no clarity to how they carried out their environmental disclosure processes. Meanwhile Emerald Minerals stated that they based their disclosures of the United Nations Sustainable Development Goals, which are targets but not a structural standard, on how they measure and report sustainability impacts (Emerald Minerals, 2024). Having standards that lack comparability and verification, which is what voluntary frameworks provide, can be a structural barrier to providing quality environmental disclosures that are relevant to the company and can be comparable to their competitors (Bosi et al., 2022).

5.1.2 Degree of Quantitative Data to Legitimise Environmental Sustainability Claims

Companies that incorporated disclosures that were supported by specific numeric data evidence could validate the credibility of their environmental sustainability claims (Clarkson et al., 2008; Zharfpeykan and Akroyd, 2022). This ensured accountability to their disclosure standards could prove their legitimacy and not providing generic 'greenwashing' statements (Khan et al., 2021).

A leader, Bellevue Gold, was able to provide data to support their water management goals. An example of this was they specified that 999,743 kL of hypersaline groundwater was removed and was done so under their annual allocation 1,000,000 kL license GWL202924 (Bellevue Gold, 2024). Providing specific numeric data, they not only track their withdrawals but framing them within the context of the regulatory boundaries. This demonstrated how their management systems are tied with

measurable performances, which strengthens the credibility and reliability of the disclosure. Iluka Resources Limited were able to investigate the components of their scope 1 and scope 2 emissions with coal accounting for approximately 51.6% of their emissions (Iluka, 2024). Providing numeric data regarding their over-reliance on coal forced them to focus on target solutions including tyre-derived fuels and biochar to lower their emissions (Iluka, 2024). Accountability through data is critical for disclosure credibility and ensures stakeholders can track their emission transition process in the future as they phase out non-renewable sources like coal (Pizzi et al., 2024).

Comparative statements from laggard companies were vague with limited data to prove their disclosure legitimacy. There were discrepancies for laggard companies, like Emerald Resources, who were "setting aside funds annually to support future offset programs aimed at reducing its carbon footprint. For FY24 US $320,000 was accrued to support carbon neutrality goals". However, there was no data provided from previous financial years (FY23, FY22 etc.) to support whether these carbons offset funds had attributed to a reduction in scope 1 and 2 emissions, (Emerald Minerals, 2024) highlighting a disconnect with their broader decarbonisation strategy.

Another laggard, Chalice Mining, had been able to report on numeric data for environmental sub-topics, including metric tonnes measurements for each of the waste generation disclosures (Disclosures 306- 3, 306-4 and 306-5). However, its accompanying narrative was limited to general statements on how waste is generated and managed within the company, offering little specificity regarding how these impacts result from their operations (Chalice Mining, 2024). Capricorn Metals had the opposite issue where they had provided extensive management strategies for both the water and biodiversity sub-topics. This included producing a 'Water Operating Strategy' and an internal 'Environment Management System' which were not sufficiently supported with the quantitative disclosures to support the legitimacy of their strategies (Capricorn Metals Ltd, 2024). Therefore, the level of integration between numeric data and their environmental management towards understanding the true environmental performance of a company (Zkarfpeykan and Akroyd, 2022; Clarkson et al. 2008).

5.1.3 Level of Site-specific Related Disclosures.

The level of site-specific data contrasted between early adopter and laggard mining companies from the sample. Providing site-level data enabled stakeholders to analyse their impacts more effectively whilst facilitating comparability across all their different mine operations (Herbohn et al., 2014; Clarkson et al., 2008). Evolution mining as an early adopter showcased specific site targets for water and environmental performance (Evolution Mining, 2024). Examples are seen through "Our target is to improve our water security by decreasing freshwater use intensity below the FY20 baseline Cowal's use of water-guard – an additive proven to reduce evaporation rates on dams while being environmentally friendly". Case studies for their site in Mt Rawdon were also provided to detail their adaptive management and data strategies for the specific site in question (Evolution Mining, 2024). These examples demonstrated how early adopters tend to disclose greater site-level data given their

understanding of the contrasting environmental characteristics and impacts between different mining sites.

From a laggard perspective, Chalice Mining didn't provide any site-specific data related to waste, only disclosing the total combined waste from all their operations (Chalice Mining, 2024. Genesis Minerals also only detail generic statements regarding their environmental compliance systems with no examples given to specific sites on how these systems would be conducted and monitored over time (Genesis Minerals Limited, 2024). Having quantitative environmental disclosures related to the four sub-topics, is crucial validation for investors and regulators when assessing the credibility of environmental management claims by companies (Belkhir et al., 2017). Furthermore, it reduces the risk of corporate greenwashing by showcasing proof of their environmental commitments from a site-level perspective (Khan et al., 2021).

5.1.4 Size of Market Capitalisation Influencing the Quality of Disclosures

Larger companies have greater capacity to collect and disclose ESG information, catering for more comprehensive reporting relating surrounding their current environmental performance (Drempetic et al., 2019). Disclosure-related theories like legitimacy theory can be a driver behind their sustainability and environmental disclosure reporting levels due to the larger financial capital they can invest (Ching et al., 2013). When companies demonstrate that environmental-related sustainability is embedded within their business strategy, it strengthens their legitimacy of their commitment (Elhabasy, 2018; Eweje, 2011; Yadava and Sinha, 2015). This suggests market capitalisation can be a determinant towards a company's capacity to invest in providing quality environmental disclosures, support a positive environmental disclosure-performance relationship identified in this study. Despite the small sample size being used for the data analysis, it is reasonable to infer how environmental and broader sustainability disclosure quality could be influenced by the market size of the company (Miklosik & Evans, 2021).

5.2 RQ2: Difference in Sub-Group Disclosure Adherence for Australian Mining Companies

This section focuses on RQ 2 in examining the differences in disclosure adherence across material environmental topics provided by the GRI Disclosure Standard. Gaps in disclosure reporting and topic frameworks can provide companies and regulators with an insight into where improvements can be made in environmental topic reporting and the associated reporting processes related to the Australian mining industry

Table 12: Environmental Disclosure Topic Mean and Median Percentage Adherence.

Environmental Disclosure Topic (/ maximum score)	Mean Percentage Adherence (%)	Median Percentage Adherence (%)
Biodiversity (/15)	40%	40%
Climate, Energy and Emissions (/30)	63%	70%
Waste (/15)	65%	73%
Water (/15)	80%	93%

Analysis showcased why biodiversity-related disclosures were reported at a lower rate than other topics. The linkage between biodiversity disclosures provided by voluntary disclosure frameworks with current Australian legislation and policies are examined. Environmental disclosure trends by companies are typically influenced by the current policy environment they are in. As climate-related policy and mandatory disclosure is being integrated into Australia, companies may place less emphasis on other environmental topics, like biodiversity when there are no legally binding frameworks showcasing they must. Subsequently, this can influence how companies decide on the materiality topics within their sustainability reports, which can differ from what is recommended by the GRI disclosure standard. Examining the current environmental governance landscape in Australia provided context to the reasons in environmental disclosure sub-topic adherence percentages resulting from the undertaking the disclosure-performance relationship analysis.

5.2.1 Company Biodiversity Reporting

Biodiversity disclosure reporting significantly lower for percentage adherence compared to the other three environmental sub-topics from the results, with a mean and median of 40%. It was observed that several mining companies with GRI certification still chose to use the GRI 304: Biodiversity Standard published in 2016 (GRI Standards, 2016), over the GRI 101: Biodiversity Standard that was updated in 2024 (GRI Standards, 2024). The main difference between the two standards is that GRI 101: Biodiversity Standard 2024 integrates the management and mitigation processes towards addressing existing biodiversity impacts compared to the GRI 304: Biodiversity Standard which was based on listing related biodiversity impacts (GRI 101, 2024; GRI 304, 2016). Despite GRI 101: Biodiversity Standard 2024 not being enforced until 2026, companies like Bellevue Gold have already adapted the 2024 standard into their reporting. This supports Duncan (2019) suggesting that companies like Bellevue Gold chose to update their biodiversity GRI disclosure to the latest standard to strengthen

their social capital, as a by-product for improving the financial capital of the company for shareholders. Furthermore, it raises the question to why other mining companies that are still aligned with the 2016 standards decided against adopting the latest 2024 standard.

The complex nature of measuring biodiversity is a challenge for companies, where biodiversity impacts can differ greatly depending on location, ecosystem type and species composition (Sonter et al., 2018). Boiral (2016) that biodiversity impacts can compromise corporate image given the nature of mining activities. Therefore, it can be reasonable that information disclosed in sustainability reporting is targeted as a neutralisation technique rather than the search for greater transparency and genuine desire for improved biodiversity outcomes (Boiral, 2016). The costs that come from increased compliance and costs from disclosure regulations also influence the current trend towards biodiversity information being limited and low quality (Ma et al., 2025). This is despite activities from mining being known to cause direct (i.e. mineral extraction) and indirect impacts (i.e. landscape fragmentation, contamination) on the environment (Sonter et al., 2018). Declines in rare and threatened species can be attributed to these ecosystem disruptions from mining activities (Sonter et al., 2018; Sonter et al., 2022). Adler et al. (2017) highlighted that despite a general increase in the quality and quantity of biodiversity scores over the years, biodiversity disclosure reporting by companies was not particularly extensive. Gaps and inconsistencies in biodiversity reporting were consistent with findings in previous studies, where disclosures were found to be as vague, incomplete or missing (Adler et al., 2017; Miklosik and Evans, 2021).

5.2.2 Current Australian Biodiversity and other Environmental Policy Landscape

There is limited alignment between the requirements of environmental legislation and voluntary disclosure frameworks utilised by for improving the structuring and quality of company environmental reporting. Currently in Australia there are national and state legislation that covering company due diligence of environmental and ecological matters. The *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) (EPBC) is the primary national legal framework that assesses and approves projects and developments that have appropriate measures in place for protecting areas of significance (Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2025). State-level legislation also exists related to mining operations. The *Biodiversity Conservation Act 2016* and *Biodiversity Conservation Act 2016* (WA) provides similar frameworks for ecologically sustainable development that protects species and habitats. The *EPBC* and state *Biodiversity Conservation Act* are forms of legislation and not a sustainability reporting guide for what companies should disclose. This presents challenges for companies as mandatory rules and regulation are the primary function of legislation rather than a piece of guidance to how company disclosures should disclose on environmental information abide to biodiversity legislation. The lack of disclosure guidance from

legislation forces companies to rely on voluntary reporting (Bhattacharyya and Yang, 2019; Clement et al., 2015;)**.**

The narrow focus of legislation like the EPBC Act means that it can only be enforced when the mine site has the potential for impacts on Matters of National Environmental Significance (Clement et al., 2015). The implementation of national strategic plans like 'Australia's National Biodiversity Strategy and Action Plan' is still not finalised, adding further uncertainty as to whether government policies can be compatible with global voluntary frameworks which companies align with (Brown, 2009; Clement et al., 2015; Hahn & Kühnen, 2013). Therefore, sites that are ongoing and already established do not fall under the act meaning there is less regulatory compliance reporting required by the company (Clement et al., 2015, DCCEEW, 2025). The multi-dimensional nature of biodiversity reporting style makes it challenging for companies to accurately report on data that is both important and measurable. Given the absence of clear frameworks that mandatorily standardise biodiversity reporting, companies can remain largely unaccountable when releasing excessive levels of information that could be seen as impressionable and greenwashing (Boiral, 2016). Beare et al. (2013) detail how companies in Canada noted a lack of direction from government towards improving the linkages between company sustainability reporting and public policy. A key hindrance is the lack of agreed-upon biodiversity reporting set in public policy, opening the possibility for companies to be selective about the depth of environmental topics reporting they choose to disclose.

Mandatory environmental topic disclosures are now being introduced under the Australian Sustainability Standards Board, with a significant focus of climate-related impacts on financial performance and value (AASB, 2024). Part of a global shift towards prioritising climate reporting, Bassen et al. (2024) details that whilst company adherence to GRI climate and regulatory related disclosures increased, the proportion of words related to biodiversity significantly declined. This reflects Australia's position towards prioritising climate-related reporting, which could come at a cost to the investment and quality of reporting for other environmental topics. Furthermore, disclosures like climate and emissions data be easily standardised and quantifiable through their disclosure requirements (Bhattacharyya and Yang, 2019; Boiral, 2016). Boiral (2016) details that biodiversity information is largely based on qualitative aspects and can be difficult to accurately compare their biodiversity performance with their competitors. Issues for government policy arise given the complex and qualitative nature of biodiversity reporting can be difficult to enforce mandatory disclosures for companies to report on.

5.2.3 Material Topic Selection and Internal Materiality Matrix

Understanding how sampled mining companies select and disclose environmental topics was investigated. Many companies have outlined their own 'internal sustainability topic matrixes' to aid the structure and focus of broader sustainability topics that were deemed of highest importance. Sustainability matrixes are quantitative measurements and narrative descriptions of issues of importance deemed by the company (Tanzil, D. & Beloff, B., 2006). The formation of these matrixes is influenced by both internal and external factors, helping prioritise and ultimately take initiative to improve their sustainability performance, including their environmental impacts (Eweje, G., 2011; Franco et al., 2021). León and Salesa (2023) highlight company comparability differences regarding materiality matrices, with none in their sample defining materiality based on the same set of sustainability issues. Commitments to specific material issues can often become too ambitious to meet, given the long transition periods and complex adoption processes that are involved with environmental collection and reporting (Ermgassen et al., 2022).

Table 13: Top 5 and Bottom 5 Materiality Topic Matrix Titles.

Company	Total Disclosure Score Percentage (%)	Has a Materiality Topic Matrix	Title of Materiality Topic Matrix
Top 5			
Evolution Mining	79%	Yes	*Sustainability Materiality Matrix*
Northern Star	76%	Yes	*Environment and Social Responsibility Approach FY24 Document*
Bellevue Gold Limited	76%	Yes	*Double Materiality Assessment Table*
Perseus Mining	74%	Yes	*Materiality and Material Sustainability Topics*
Iluka Resources Limited	71%	No	_____
Bottom 5			
Genesis Minerals	8%	No	_____
Emerald Resources	39%	No	_____
Capricorn Metals	45%	Yes	*Material Topics*
Chalice Mining Lithium	45%	Yes	*Top 10 Material Topics Identified by Stakeholders*
Lynas Rare Earths	58%	Yes	*Stakeholder Engagement and Material Topics*

There was a common theme between how internal matrices were titled and aligned 'early adopter and laggard' sampled mining companies, as seen in Table 13. 'Early adopter' companies like Evolution Mining and Bellevue Gold, had incorporated materiality processes where high priority topics linked to the GRI 2024: Mining Sector Standard. However, it was interesting to see that the two lowest disclosure scoring companies (Genesis Minerals and Emerald Resources) did not specify having a material topic process or matrix.

From an application perspective, the use of these internal matrixes enabled data capture and disclosure of companies to be efficient and specific to their sustainability goals (Zharfpekan & Akroyd, 2022). This stems from ongoing criticisms that sustainability reports often lack structure and comparability related to how they are established (Franco et al., 2021, Zharfpeykan & Akroyd, 2022). Internal sustainability matrixes also enabled companies to be selective around what disclosures are the most important. This is particularly when acting on environmental sustainability initiatives can be costly and time-consuming (Ekins and Zenghelis, 2021). For example, one sample mining company Liontown Resources stated that 'Biodiversity' was not a relevant sustainability topic to their operations and subsequently did not feature in their top 12 (Liontown Resources, 2024). Whilst there was no deeper explanation why biodiversity was omitted from their reporting, it raised whether the cost of biodiversity disclosure reporting outweighed the benefit of the biodiversity benefits from being selected in their prioritised topics list.

There is limited consistency to how companies approach the same material issue in their sustainability reporting given that environmental topic disclosure quality can differ greatly between companies in the same industry. Analysing how and why differences in disclosure adherence exist for companies can be the result of what topics they choose to 'report on'. Observations can be made to suggest that companies provided higher quality disclosure when they had a matrix or assessment system that focused on the incorporating material environmental topics identified by the GRI. However, it is noted that the lack of standardisation to how internal company performance management systems are established can be a barrier towards achieving an accurate disclosure-performance assessment (Franco et al., 2021, Zharfpeykan and Akroyd, 2022).

5.3 Theoretical and Practical Implications

Theoretical and practical implications can be drawn from the study results. Theoretical implications from this research supports the applicability of disclosure related theories. The r-squared coefficient of 0.69 was an acceptable explanatory value to detail that total environmental disclosure is related to the performance scores provided by S&P Global. Signalling and legitimacy theories were supported with mining companies not only signalling their transparency and performance credibility publicly by providing environmental sustainability disclosures (Brooks and Oikonomou, 2018), but also using environmental disclosure as a strategic tool to legitimise their activities resulting from external stakeholder and regulatory pressures (Ching et al., 2013). As higher disclosure adherence can be associated with higher environmental performance, it highlights that companies do see environmental benefits from increased sustainability commitment and investment (Brooks and Oikonomou, 2018; Papoutsi and Sodhi, 2020). Furthermore, uncovering the positive correlation supported the findings of previous academic research that also had a positive disclosure-performance relationship relating to company ESG topic disclosures (Ching et al., 2013; Laskar, 2024; Morhardt et al., 2002; Rüger & Maertens, 2023; Yadava & Sinha, 2015).

Practical implications involved adding onto existing literature that had previously explored gaps and inconsistencies of company reporting related to the mining industry and the requirements set by the disclosure frameworks. Furthermore, the establishment of the early adopter-laggard analysis enabled comparative benchmarking between high- and low-quality disclosure. This suggests that stakeholders and investors could make informed evaluations of a company environmental performance based on the quality of environmental disclosure detailed (León and Salesa, 2023).

5.4 Limitations and Future Recommendations

5.4.1 Sample Selection and Size

The size and variety of companies included in the sample is relatively small compared to similar research using mining companies as their sample dataset (Adler et al., 2017; Miklosik and Evans, 2019). The selection process of mining companies was dependent on their performance score derived from 2024 S&P Global Environmental Scores list being publicly accessible. This narrowed the scope of the study to only 17 companies given that many other mining Australian Stock Exchange-listed companies, despite having publicly available 2024 sustainability data, had their ratings restricted on the S&P Global website. Therefore, the findings may not be fully representative of the wider mining industry because of these restrictions. Future research could be centred around integrating other rating or scoring systems that calculate the environmental performance of companies to enable more mining companies to be included in the sample study. Additionally, sustainability data and performance ratings could be measured over multiple years to give a clearer indication of how disclosure quality and environmental performance develop over multiple years.

5.4.2 Subjectivity in Disclosure Selection and Scoring

The GRI Disclosure Standard incorporated material environmental topics relevant to the Australian mining industry (GRI, 2025)**.** Using a disclosure framework that is based off one existing voluntary framework may be restrictive, differing from previous research that constructed their own individualised sustainability disclosures that were formulated from a variety of policy documents and frameworks (Papoutsi and Sodhi, 2020). Future recommendations could incorporate selecting disclosures that go beyond just the GRI to develop a holistic framework that could better encapsulate the environmental disclosures of greatest concern for companies in mining industry.

5.4.3 Reliance on Secondary Data Sources

The data analysis process involved interpretive content analysis of publicly available company sustainability disclosures. The decision not to undertake primary data analysis (i.e. interviews) limited the significance of the results to be supported by direct stakeholder insights and contextual understanding. Future recommendations could include primary interviews with company sustainability executives and stakeholders from the companies sampled. Staging primary interviews can add context

and explanations to why patterns and potential gaps exist in their company disclosures. Interviews could also provide an internal perspective on why industry leaders prioritise and maintain high quality environmental disclosure and why laggards struggle (i.e. limited financial and sustainability data resource availability).

Chapter 6: Conclusion

This study sought to analyse the relationship between environmental disclosure and performance, and whether the quality of disclosure provided by companies can be an indicator for their environmental performance. With environmental related sustainability reporting a higher priority for investor and stakeholder evaluation (Papoutsi and Sodhi, 2019), this research provided a foundation for company disclosure quality comparisons that had a distinct focus on incorporating relevant and material environmental topics. Key distinctions were observed between Australian mining companies that had high quality disclosure (early adopters) with those with low quality (laggards). The early adopter-laggard analysis suggested that disclosure quality differences stem from both capacity (resource availability, technical expertise) and commitment (strategic prioritisation of sustainability). Company disclosures that incorporate data-based evidence and site-specific information resulted in scores that were more aligned with the given GRI requirement. Companies displaying larger market capitalisation also produced higher quality disclosure scores than those with a smaller market capitalisation, given the greater resources and stronger stakeholder pressure that exists (Brooks and Oikonomou, 2018; Carvajal and Nadeem, 2023; Miklosik and Evans, 2021)

Breaking down disclosures into specific environmental sub-groups further uncovered disclosure gaps in environmental sustainability reporting across the Australian Mining Industry. Sub-topics related to biodiversity scored significantly lower than the other three sub-topics, raising whether existing policies and frameworks effect the quality of company biodiversity reporting. The wide spectrum of biodiversity impact reporting creates barriers towards establishing standardised disclosures that can be standardised across the entire industry (Boiral, 2016)**.** Aligning disclosures that meets state and national legislation can present challenges when companies use voluntary disclosure frameworks, like the GRI, to assist with their environmental reporting structures (Bhattacharrya and Yang, 2019)**.** Implications of this study supported existing disclosure-related theories and research that companies see benefits by legitimising their sustainability actions by providing public environmental disclosures. Additionally, these findings offer insights investors, stakeholders and regulators regarding the environmental performance of a company being related to their depth and quality of material environmental disclosures.

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Legislation

Biodiversity Conservation Act 2016 (NSW)

Biodiversity Conservation Act (WA)

Environmental Protection and Biodiversity Conservation Act 1999 (Australia)

Appendix 1: GRI 14: Mining Sector Disclosure Requirements

Climate, Energy and Emissions

Disclosure	*Summary of Disclosure Requirements listed by the GRI*
201-2 Financial implications and other risks and opportunities due to climate change	Risks and opportunities posed by climate change that have the potential to generate substantive changes in operations, revenue, or expenditure, including description of risk, impact, financial implications, methods and costs
302-1 Energy Consumption within the organisation	Total fuel consumption within the organisation from non-renewable and/or renewable sources, in joules or multiples, and including fuel types used.
302-2 Energy Consumption outside the organisation	Energy consumption outside of the organization, in joules or multiples.
302-3 Energy Intensity	Energy intensity ratio for the organization.
305-1 Energy Direct (Scope 1) GHG Emissions	Gross direct (Scope 1) GHG emissions in metric tons of CO2 equivalent.
305-2 Energy Indirect (Scope 2) GHG Emissions	Gross location-based energy indirect (Scope 2) GHG emissions in metric tons of CO2 equivalent.
305-3 Other indirect (Scope 3) GHG emissions	Gross other indirect (Scope 3) GHG emissions in metric tons of CO2 equivalent.
305-4 GHG Emissions Intensity	GHG emissions intensity ratio for the organization.
305-5 Reduction of GHG Emissions	GHG emissions reduced as a direct result of reduction initiatives, in metric tons of CO2 equivalent.
305-7 Nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions	Significant air emissions, in kilograms or multiples, for each of the following: i. NOx ii. SOx iii. Persistent organic pollutants (POP) iv. Volatile organic compounds (VOC) v. Hazardous air pollutants (HAP) vi. Particulate matter (PM) vii. Other standard categories of air emissions identified in relevant regulations

Biodiversity

Disclosure	*Summary of Disclosure Requirements listed by the GRI*
101-1 Policies to halt and reverse biodiversity loss	a. describe its policies or commitments to halt and reverse biodiversity loss, and how these are informed by the 2050 Goals and 2030 Targets in the Kunming-Montreal Global Biodiversity Framework; b. report the extent to which these policies or commitments apply to the organisation's activities and to its business relationships; c. report the goals and targets to halt and reverse biodiversity loss, whether they are informed by scientific consensus, the base year, and the indicators used to evaluate progress
Disclosure 101-2 Management of biodiversity impacts	Report how it applies the mitigation hierarchy by describing: i. actions taken to avoid negative impacts on biodiversity; ii. actions taken to minimize negative impacts on biodiversity that were not avoided; actions taken to restore and rehabilitate affected ecosystems, including the goals of the restoration and rehabilitation, and how stakeholders are engaged throughout the restoration and rehabilitation actions; iii. iv. actions taken to offset residual negative impacts on biodiversity; v. transformative actions taken and additional conservation actions taken;
Disclosure 101-4 Identification of biodiversity impacts	Explain how it has determined which of its sites and which products and services in its supply chain have the most significant actual and potential impacts on biodiversity.
Disclosure 101-5 Locations with biodiversity impacts	Report the location and size in hectares of its sites with the most significant impacts on biodiversity;
Disclosure 101-6 Direct Drivers of biodiversity loss	For each site reported under 101-5-a where its activities lead or could lead to land and sea use change, report: the size in hectares of natural ecosystem converted since a cut-off or reference date, the cut-off date or reference date, and the type of ecosystem before and after conversion;
Disclosure 101-7 Changes to the state of biodiversity	For each site reported under 101-5-a, report the following information on affected or potentially affected ecosystems: i. the ecosystem type and hectares for the base year;

Waste

Disclosure	*Summary of Disclosure Requirements listed by the GRI*
Disclosure 306-1 Waste Generation and Significant waste-related impacts	For the organisation's significant actual and potential waste-related impacts, a description of inputs, activities, and outputs. Whether these impacts are generated from their own activities or upstream/downstream
Disclosure 306-2 Management of significant waste-related impacts	Actions, to prevent waste generation in the organisation's own activities and upstream and downstream in its value chain, and to manage significant impacts from waste generated.
Disclosure 306-3 Waste Generated	Total weight of waste generated in metric tons, and a breakdown of this total by composition of the waste.
Disclosure 306-4 Waste diverted from disposal	Total weight of waste diverted from disposal in metric tons, and a breakdown of this total by composition of the waste. Includes hazardous and non-hazardous waste that prepared for reuse, recycled or other reycled operations
Disclosure 306-5 Waste directed to disposal	Total weight of waste directed to disposal in metric tons, and a breakdown of this total by composition of the waste. Include Incineration (with and without energy recovery), landfilling and other disposal operations

Water

Disclosure	*Summary of Disclosure Requirements listed by the GRI*
Disclosure 303-1 Interactions with water as a shared resource	A description of how the organization interacts with water, including how and where water is withdrawn, consumed, and discharged, and the water-related impacts the organization has caused or contributed to, or that are directly linked to its operations, products, or services by its business relationships (e.g., impacts caused by runoff).
Disclosure 303-2 Management of water discharge-related impacts	Description of any minimum standards set for the quality of effluent discharge, and how these minimum standards were determined. Includes facility standards, internally developed water quality guidelines and profile of the receiving waterbody.
Disclosure 303-3 Water withdrawal	a. Total water withdrawal from all areas in megaliters, and a breakdown of this total by the following sources, if applicable: I. Surface water; II. Groundwater; III. Seawater; IV. Produced water; V. Third-party water.
Disclosure 303-4 Water discharge	a. Total water discharge to all areas in megaliters, and a breakdown of this total by the following types of destination, if applicable: i. Surface water; ii. Groundwater; iii. Seawater; iv. Third-party water, and the volume of this total sent for use to other organizations, if applicable.
Disclosure 303-5 Water consumption	a. Total water consumption from all areas in megaliters.

Appendix 2: Example of Disclosure Company Scoring Table

Bellevue Gold Resources – *Early Adopter*

Summary: One of the few mining companies that uses the latest GRI Biodiversity framework. Heavy Emphasis is placed on climate reporting. Provide quality data tables that specifically link to the GRI 2024: Mining Sector standards.

Disclosure	Score (/3)	Reasoning	Page reference
302-1 Energy consumption within the organisation	3	Specify total energy consumption from both non-renewable and renewable sources	FY24 Data Table
302-1 Energy consumption outside the organisation	3	Provide GRI disclosure that they have 0 energy consumption outside the organisation	FY24 Data Table
302-3 Energy intensity	0	No energy intensity provided in the data tables	FY24 Data Table
305-1 Energy Direct (Scope 1) GHG emissions	3	Total Scope 1 emissions for FY24 given	p.20
305-2 Energy Indirect (Scope 2) GHG emissions	3	Total Scope 2 emissions for FY24 given	p.2
305-3 Other indirect (Scope 3) GHG emissions	0	Not mentioned in report	
305-4 GHG Emissions Intensity	3	Emissions intensity of CO2e/oz for 9-month gold production	FY24 Data Table
305-5 Reduction of GHG Emissions	0	Not mentioned in report	p.20
305-7 Nitrogen oxides (NOx), sulfur oxides (SOx), and other significant air emissions	3	Air emissions provided for all types	FY24 Data Table
201-2 Financial implications and other risks and opportunities due to climate change	3	Have identified 9 physical and 18 transition risks associated with the TCFD risk categories. Highlight how establishing consistent disclosures and sustainability metrics will enable improved progress towards reaching their zero emission goals	FY24 Data Table
101-1 Policies to halt and reverse biodiversity loss	3	Its biodiversity plan is in its Environmental Policy action plan. Further they detail how their compliance to the EPBC Act 1986 (WA) in minimising their biodiversity impacts.	p.26
101-2 Management of biodiversity impacts	3	A mitigation hierarchy has been established. They detail how surveys have been conducted for all vegetation communities within the Project area. However, there is no	p.26

		specific detail beyond this that are management practices related to the hierarchy.	
101-4 Identification of biodiversity impacts	0	Not mentioned in report	
101-5 Locations with biodiversity impacts	3	Provides sites with most significant impact on biodiversity and distance from ecologically sensitive areas	FY24 Data Table
101-6 Direct drivers of biodiversity loss	3	Detail that there are no direct drivers of biodiversity loss	FY24 Data Table
101-7 Changes to the state of biodiversity	0	Not mentioned in report	
306-1 Waste generation and significant waste-related impacts	2	Doesn't explicitly specify activities from their operations that lead to waste. However, they recognise that waste streams do exist.	p.27
306-2 Management of significant waste-related impacts	3	Established a waste hierachy for their management. Detail their drive to reduce the volume of material that would then be needed for later recycling or disposal	p.27
306-3 Waste generated	3	Provide waste rock and non-mineral waste (tonnes)	FY24 Data Table
306-4 Waste diverted from disposal	3	Provides total weight of hazardous waste recycled	FY24 Data Table
306-5 Waste directed to disposal	0	Not mentioned in report	
303-1 Interactions with water as a shared resource	3	Provides context to how the projects intersect with the groundwater table. Details around how water is being recycled and re-used from plant and processing ponds. Engagement is also conducted with the Tijwarl Native Title Holders on regulatory compliance issues related to water monitoring	p.22
303-2 Management of water discharge-related impacts	3	Approach to water stewardship is addressed in their internal Environmental Policy framework. Licenses have been obtained with the Department of Water and Environmental Regulation (DWER). Further, they are developing a Groundwater Management Plan to be formalised by FY25.	p.22
303-3 Water withdrawal	3	Total water withdrawal from all sub-sources is provided	FY24 Data Table
303-4 Water discharge	3	Total water discharged from all sub-sources is provided	FY24 Data Table
303-5 Water consumption	3	Total water consumption from all areas	FY24 Data Table

Link for the remaining Disclosure Company Scoring Tables

Appendix 3: Summary of Company Environmental Sub-Topic Disclosure Score Percentages and Environmental Performance Score

Australia Metal and Mining Company	Climate, Energy and Emissions (/30) %	Biodiversity (/18) %	Waste (/15) %	Water (/15) %	Total Disclosure (/78) %	2024 S&P Global Environmental Performance Score (/100)	Adopter Category
Bellevue Gold Limited	60%	67%	73%	100%	76%	40	*Early Adopter*
Capricorn Metals	33%	28%	67%	47%	33%	16	*Laggard*
Chalice Mining Lithium	57%	28%	53%	33%	45%	39	*Laggard*
Emerald Resources	40%	28%	27%	60%	38%	19	*Laggard*
Evolution Mining	60%	61%	100%	100%	79%	56	*Early Adopter*
Genesis Minerals	0%	11%	7%	20%	8%	15	*Laggard*
Gold Road Resources	67%	28%	100%	100%	74%	53	*Majority*
Iluka Resources Limited	70%	22%	87%	93%	71%	46	*Early Adopter*
Liontown Resources	53%	0%	100%	80%	59%	26	*Majority*
Lynas Rare Earths	60%	33%	40%	80%	56%	40	*Laggard*
Mineral Resources Limited	50%	50%	100%	80%	68%	56	*Majority*
Northern Star	66%	33%	100%	100%	76%	49	*Early Adopter*
Perseus Mining	77%	33%	100%	93%	74%	51	*Early Adopter*
Ramelius Resources Limited	60%	39%	47%	100%	64%	38	*Majority*
Regis Resources	70%	22%	80%	80%	67%	42	*Majority*
Sandfire Resources Limited	63%	56%	40%	100%	67%	44	*Majority*
South32 Limited	60%	33%	53%	100%	64%	54	*Majority*
Average	**56%**	**34%**	**69%**	**80%**	**60%**	**40**	

Appendix 4: Residuals and QQ Plot – *Total Disclosure*

Residuals had been incorporated into this results analysis to test regression assumption. Assessing the model's validity by conducting these analyses helped explain the degree of confidence for the environmental disclosure-performance relationship. The total residual plot checked the linearity and homoscedasticity (equal spread) of the residuals, whilst the QQ plot checked the normality of the residuals.

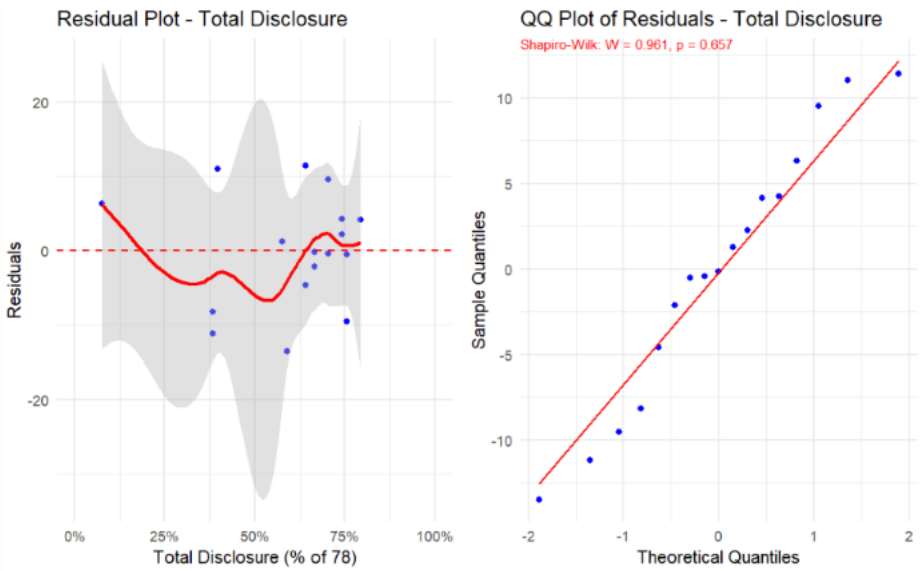

Figure 11: Residual and QQ Plot of Residuals - Total Disclosure.

For the residual plot, there are some residuals scattered around the red zero line but are not perfectly even. Greater density exists around the mid-to-high fitted values (40-50). Large residuals also exist above and below the residual line, influenced greatly by the small sample size of the data. There is no strong curved pattern (suggestion of non-linearity), indicating the level of variation that around the fitted line.

The QQ plot tested the normality of the residuals. Points laid close to the diagonal line, particularly in the middle range. Deviations did exist at both extremes where residuals are fell below (negative tail) and (positive tail) the line. However, it can be suggested that this data is normally distributed. A Shapiro Wilk score of 0.961 is close to the perfect normality of 1, suggesting that the data can be seen as 'very reasonably' normal.

Appendix 5: Residuals and QQ Plot – *Sub-Topic Disclosures*

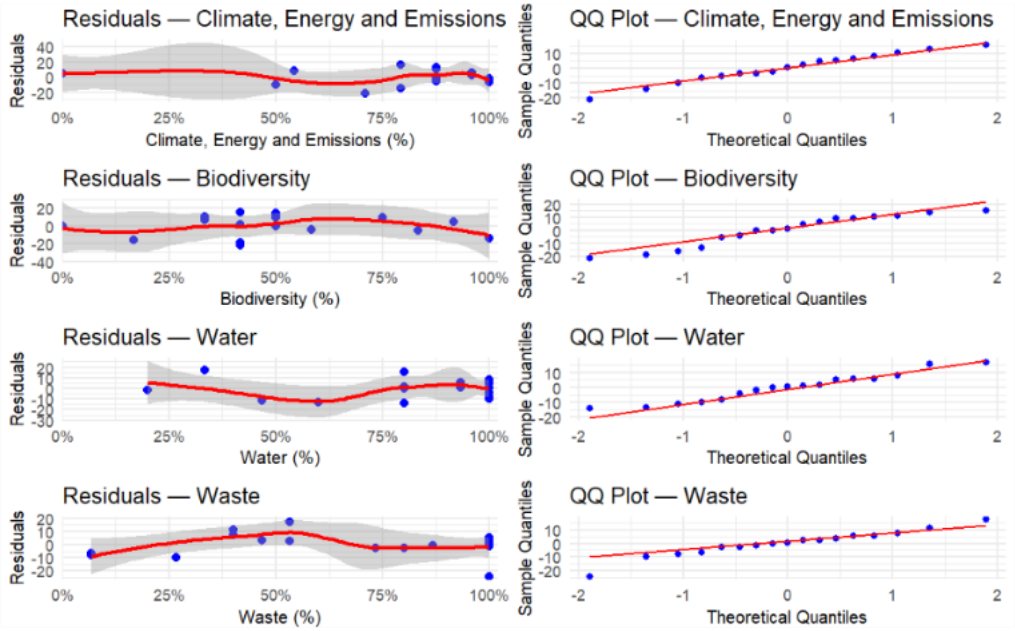

Figure 12: Residuals and QQ Plots for Sub-Topic Disclosures.

Consistent with the procedure for the total disclosure score, the same residuals and qqplot was applied to the sub-groups, as seen in figure 12. The Shapiro-Wilk tests all displayed a number to suggest that the data is reasonably normal. All p-values are greater than 0.05, suggesting there is no evidence that the data deviates from normality.

Table 14: Shapiro-Wilk tests for Sub-Topic Disclosures.

Environmental Disclosure Topic	W	p-value
Climate, Energy and Emissions	0.982	0.972
Biodiversity	0.923	0.165
Water	0.958	0.602
Waste	0.950	0.450